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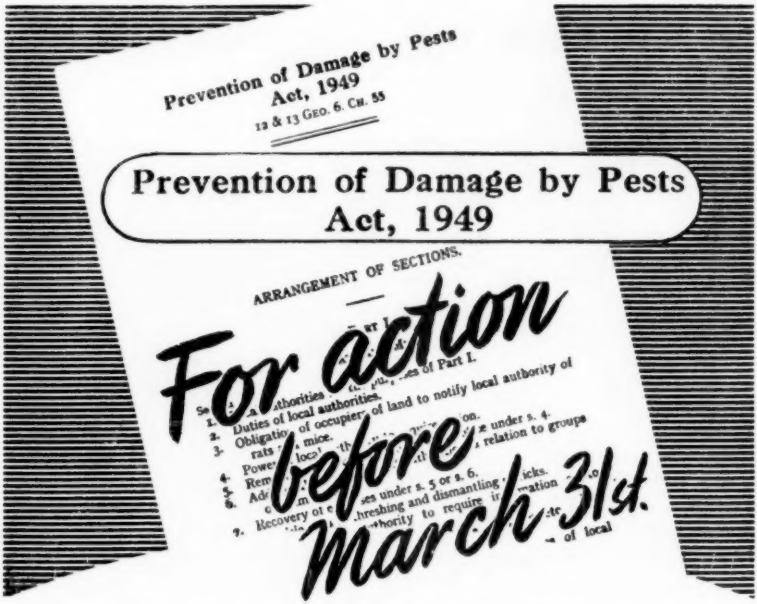

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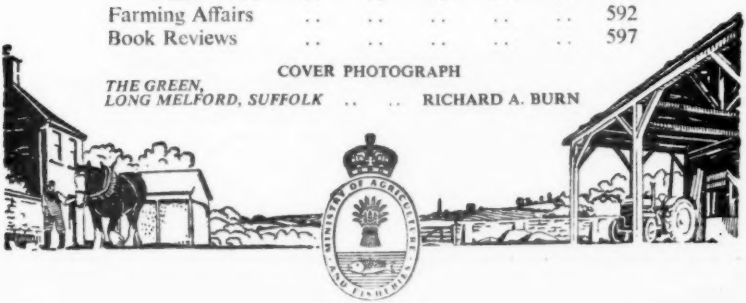

AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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FOURTEENTH INTERNATIONAL VETERINARY CONGRESS

PROFESSOR T. DALLING, M.A., M.R.C.V.S.

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INTERNATIONAL Congresses in many subjects have been much in evidence during the past few years. It was to be expected that, because of war-time interruptions, opportunities would be taken to revive them as soon as possible. This applied to the International Veterinary Congress which held its fourteenth meeting in London in August, 1949. This is the third occasion on which London has been selected as the meeting place. Representatives and delegates from many countries attended and took part in the discussions. The theme of the Congress was food production, and all the papers presented and the subjects discussed had an intimate bearing on it.

The Congress had as its President Sir Daniel Cabot who, until August, 1948, was Chief Veterinary Officer of the Ministry of Agriculture. The official opening was carried out by the Right Hon. Hector McNeil, Minister of State, and a plenary session was held each day at which important and interesting lectures were given by well-known authorities on the various subjects dealt with. Included among these lectures were the following: the world's food situation (Lord Boyd Orr); the veterinary profession's contribution to the world's milk supply (Professor H. C. Bendixen, Denmark); the veterinary profession's contribution to the world's meat supply (Dr. C. S. M. Hopkirk, New Zealand); the veterinary profession's contribution to the world's poultry and egg supplies (Dr. J. R. Beach, United States of America); the veterinarian and the breeding and rearing of animals (Professor N. Lagerlof, Sweden); and veterinary education and its application to world problems (Dr. W. R. Wooldridge, Great Britain).

In the sectional meetings subjects were dealt with in detail, of which the following are some of the outstanding items.

Contagious Abortion Brucellosis in cattle (contagious abortion) was dealt with from two main angles—eradication and control. In Finland, for example, a "stamping out" policy has been in operation since 1945. The measures adopted, which are implemented at State expense, include the examination of milk, the carrying-out of agglutination tests and the bacteriological examination of foetuses and placentae in cases of abortion. Since the scheme started, over 3,000 herds have been declared free and it is stated that some 8,000 herds in the country are free from infection.

Control of brucellosis by vaccination was debated at length : the general conclusion was in favour of the use of Strain 19 vaccine. An interesting contribution from Great Britain dealt with the ridding of brucella infection from seven herds in five years : all non-pregnant animals were vaccinated during the first year and thereafter all calves born in the herd were vaccinated once only, when about six months old. Although the average infection in the herds at the beginning of the work was 42 per cent, at the end of the five-year period, brucellosis had been eliminated. In the same contribution, agglutination titres following vaccination were discussed : it was shown that about 25 per cent of animals vaccinated as calves retained high titres for some years, the remainder showing negative or very low titres before they reached maturity. Animals vaccinated at an older age tend to retain agglutination titres for a much longer period.

From New Zealand evidence was presented to show that the use of Strain 19 vaccine in calves does not influence subsequent fertility : large numbers of animals were observed and the results indicate, as is also found in other parts of the world, that the control of brucellosis by vaccination has a marked beneficial influence on some of the diseases associated with fertility.

An outstanding paper was presented from Denmark. It dealt with the incubation period of infection with *Br. abortus* : it was shown that the length of the incubation period is inversely proportional to the stage of development of the foetus when infection takes place. Thus the incubation period following infection at or near service was 225 days, while in animals seven months pregnant it was only 53 days. Because of the long incubation period following infection at service, we now have an explanation why it is comparatively rare to find abortions due to *Br. abortus* occurring before the fifth, sixth or seventh month of pregnancy. It also explains why it is sometimes difficult to show the source of infection in some herds which were previously free from the disease.

Bovine Mastitis There was general agreement that bovine mastitis can be well controlled by the injection of drugs and antibiotics into the udder through the teat canal. For the prevalent form of the disease, associated with *Streptococcus agalactiae*, penicillin is, at the moment, the product of choice. Reports were made of large-scale trials in this country, and stress was laid on the necessity for the prevention of reinfection of the udder following the elimination of the micro-organisms. Good milking and cowshed hygiene are essential in the control of the infection.

Reports from Norway stressed the importance of staphylococci as agents concerned in bovine mastitis, and an account was given of a scheme sponsored by the State whereby diagnostic laboratories are used for the examination of milk samples, and veterinarians carry out clinical examinations on the herds belonging to farmers who join the voluntary scheme. Further observations in Norway suggest that in streptococcal mastitis the micro-organisms can enter the udder only during lactation.

Workers in the United States reported on predisposing causes of mastitis, and there was some evidence from their observations that, by new techniques, it was possible to detect abnormalities in milk, associated with mastitis, before evidence of bacterial invasion of the udder can be demonstrated. There was a suggestion that high milk yields are linked with susceptibility to mastitis and that one of the predisposing factors may be insufficient rest of the udder between lactations.

Bovine Tuberculosis A lengthy discussion took place on the control of bovine tuberculosis. The various methods in the different countries were described and claims were made for the benefits attached to them. It is agreed that, no matter how the details of an eradication or control scheme may vary, the accurate use of tuberculin as a diagnostic agent is the centre around which all work must be carried out.

Considerable progress has been made in Denmark, for example. By August, 1948, it was shown that 99.2 per cent of all the herds in the country were free from tuberculosis ; and it was only fifteen years ago that infection was stated to be present in from 70 to 90 per cent of the herds and from 30 to 40 per cent of the cattle. Much credit for this rapid progress must go to the close collaboration between the State veterinary authorities, the veterinary profession and the co-operative dairies. In Finland it appears that bovine tuberculosis has been eradicated, although 3 per cent of the cattle still react to tuberculin at the annual tests. It has been shown that these reactions are largely concerned with the infection of cattle not with bovine tuberculosis but with the human and avian strains of the tubercle bacillus. In Holland legislation has recently been introduced which makes it compulsory for farmers to have their cattle examined for the presence of tuberculosis. Good progress has already been made in that country ; in Fresia, for example, working voluntarily, the incidence of reactors to the tuberculin test has fallen from 35 to 2 per cent. In Switzerland, also, large areas are now free from bovine tuberculosis. Much stress is laid in that country on the methods of calf-rearing in order to minimize the chances of infection. Observers in Great Britain reported on the attested and T.T. herd schemes. It was shown that whereas in 1931 there were 895,000 cattle in tubercle-free herds, by 1948 the number had risen to 1,704,000.

Infertility in Cattle Much of the discussion on infertility in cattle centred around infections of the genital tract. It became obvious that the clearing of brucellosis from herds resulted in a marked decrease in the incidence of infertility, and evidence was presented to show that in some herds infertility is associated with a combination of *Br. abortus* and common pyogenic organisms in the genital tract. Reports from Holland referred to a condition, termed "enzootic sterility," which is believed to be associated with the presence of the micro-organism *Vibrio foetus*. Bulls may become infected and perhaps pass on the infection to cows and heifers during service. The disease is truly venereal, but females seem to develop an immunity so that by the next breeding season after infection they breed normally. Tests are being worked out whereby it will be possible to diagnose the infection in animals before clinical evidence of the disease appears.

From Great Britain came an interesting contribution on the possible relationship of nutrition to fertility. It was suggested that there may be a calcium-phosphorus imbalance, probably in conjunction with a trace element deficiency, which can lead to impaired breeding efficiency in the herd. We shall doubtless hear more of this in the future. Nutritional causes of infertility were also dealt with by Hungarian workers, who associated irregular carotene supplies with temporary lack of sexual desire, cessation or irregularity of the oestrus cycle and low rate of conception.

An interesting observation from Belgium was that bovine sperm can retain its fertilizing capacity for at least 55 hours in the uterus and oviducts.

Diseases of Pigs Three important diseases of pigs were discussed—swine fever, swine influenza and Teschen disease. The Australian contributions on SWINE FEVER dealt with an outbreak in

1942, and from a study of the properties of the virus causing the disease, recommendations were made on the means which should be adopted to stamp out an infection introduced into a country in which the disease does not normally exist. One important statement was that, in such a country, the use of immunizing agents should be prohibited. Although, under certain conditions, the swine fever virus can live for long periods, it was found that infected premises in Australia were no longer infective forty-eight hours after diseased pigs were removed. It was also interesting to learn that bacon prepared from the carcass of an infected pig retained infection for at least 27 days, and probably longer.

In countries in which swine fever exists, vaccination was advocated for the control of the disease. While much immunization in the United States of America is carried out by the simultaneous use of virulent swine fever virus and immune serum, other countries are using crystal violet vaccine. Much work has been done in some countries on the methods of preparation of this type of vaccine ; they include Great Britain, Argentina, and Austria.

SWINE INFLUENZA and its relationship to human influenza formed the subjects of discussion from Sweden and Great Britain. One of the important findings of the Swedish workers was that the virus associated with swine influenza may, by itself, set up the pneumonia commonly associated with swine influenza. There have been many discussions on whether various types of micro-organisms were necessary, in addition to the virus, for the causation of the lesions in the lungs. Workers in Great Britain agree with the findings of their Swedish colleagues. From Great Britain also comes the view that we must consider the possibility of the relationship between the human and pig strains of influenza virus.

TESCHEN DISEASE (infectious encephalomyelitis of swine) is not present in this country ; it gives rise, however, to considerable economic loss in parts of central Europe. Reports presented by Austrian workers indicated the difficulty in making a diagnosis and in differentiating some forms of the disease from swine fever.

Diseases of Sheep The discussions on sheep were mostly concerned with parasitic infestation (external and internal) and nutrition. From Australia reports were presented on the use of anthelmintics in controlling stomach and intestinal round worms : although the drug phenothiazine has given good results, there is still need for research work for the discovery of a multi-efficient product. In connection with the use of phenothiazine, it was reported from New Zealand that keratitis (inflammation of parts of the eye) may be a sequel in calves if the animals are exposed to direct sunlight on the day following administration. An explanation, following experimental work, was given of the reasons for the occurrence.

From Great Britain came a paper on liver fluke infestations, in which the most recently acquired knowledge of the life history of the parasite, the habitats of the snail host (*Lymnaea truncatula*) and the methods of control of the snail were presented. It appears that small areas only of a farm may be infested by the snail and that suitable treatment of them will control the number of snails and hence lessen the chances of survival of the liver fluke outside the body.

Stages of a tapeworm which infest sheep are found in certain mites which live in pastures. A report from Great Britain showed that the highest numbers of these mites are found on permanent grassland, and it is therefore recommended that, in order to avoid tapeworm infestation, young stock should not be grazed on such pastures.

Diseases of Poultry Fowl pest (Newcastle disease) was naturally a prominent subject. Reports of research work and methods of control were received from many countries. The type of the infection in the United States of America was compared with that found in Europe and in this country. Methods of vaccination were described, and the experiences of observers in different countries formed interesting and important contributions. A paper from Great Britain discussed the methods of control practised here, namely, the legislative control of movements of fowls, markets, etc., and the slaughter of affected and contact birds, as opposed to vaccination. Work done in Holland indicated that two different viruses are responsible for fowl pest and for the disease known as duck plague.

A contribution from Australia dealt with investigation into fowl coryza (catarrh), in which it was shown that the disease is associated with an infective agent, *Haemophilus gallinarum*. From observations on the disease under natural conditions it seems doubtful if an immunity follows an attack of the disease; it seems unlikely, therefore, that artificial immunization can be used as a control measure.

A MILK YIELD PROBLEM

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THE system of milk recording on a broad national scale and the subsequent analysis of the data have yielded a great deal of interesting material. One intriguing fact brought to light is the east-west trend in milk production. Speaking generally, yields are higher in the east; for example, the national milk records annual report for 1948 shows that, in spite of lower rainfall, the Eastern Region had the highest herd average. Broadly speaking, the trend in butterfat percentage is the opposite of that of milk yields—for, on the whole, butterfat is higher in the west than in the east. Edwards[1] was the first to draw attention to these facts.

At first sight this trend may appear to be due to breed differences, and to the west having a higher proportion of the lower-producing breeds. To an extent this may be so, but there is still the problem of differences in milk yields which appear within the same breeds kept in the east and west. Edwards working on 1944-45 milk records showed that British Friesians and Shorthorns in Essex yielded more than the same breeds in Lancashire, the superiority having been 250 and 170 gallons respectively. In this connection it is perhaps significant that the highest yielding herd of the Welsh Black breed is located on the Berkshire downs, and not in its native strongholds.

A further possibility is that genetic influences are responsible, and that yield differences are due to the formation of genetically self-contained local types. However, the widespread habit of buying bulls from fairly far afield, would seem to preclude this. For example, no county apparently gets less than 7 per cent of its Shorthorn bulls from Cumberland[2], and the importation of bulls of the Ayrshire and Friesian breeds into the west and to Wales must be on a considerable scale.

Again, management and food supplies have been mentioned as being particularly relevant to the issue. It may be true that the eastern counties are often in a more satisfactory position with regard to winter food, because of the higher proportion of arable land than the west, where much reliance is placed on the hay crop, the quality of which can fluctuate a great deal according to conditions of harvest. To offset this, however, there is the favourable summer condition with good supplies of quality grass. General management conditions should not be dissimilar; indeed in the west, with a relatively high proportion of small family farms involving a large degree of personal supervision by the farmer and his family, conditions would appear to be distinctly favourable.

Why Flesh at the Expense of Milk? At the College Farm, Bangor, the reasons for the relatively low yields of the dairy herd have been a matter of speculation. It is realized that until recently the emphasis on the breeding policy with the two dual-purpose herds has been as much on beef as on milk, and that the demands of a large hill flock are to some extent incompatible with dairy farming. After making allowance for these conditions, however, the milk yield is too low, while all cattle fatten very readily. The milking herd consists of between 60 and 70 cows, one half being Welsh Blacks, and the remainder Shorthorns. The herd has long been attested, and every endeavour is made to carry out a constructive breeding policy. A number of the Shorthorns are of good Bates blood, and care is taken when the occasion arises, to purchase bulls from high yielding herds. With the Welsh Black section of the herd, the difficulty of finding bulls with good milk records is very real; indeed it is apparent that if the breed is to hold its own in the immediate future, more recording must be undertaken.

Despite the obvious difficulty of carrying out a sound breeding policy with the Welsh Blacks, it is interesting to note that in the past there has been little difference in the milk yields of the two breeds—both breeds, of course, are kept under similar management conditions. On the score of types of bulls used, it would appear that the genetic potentiality of the Shorthorns should have been higher than that of the native breed, which seems to indicate that there is some limiting factor present. Again, on the basis of conformation, the Shorthorns are much nearer the standard requirements of what a good dairy cow should be. Despite this, there is not a great deal of difference between the two breeds, and judged by modern standards of yields, both breeds leave much to be desired.

At the College Farm the pastures are maintained in good condition, and every four to six years or so go through the normal oats-oats-roots-oats rotation before being put down to grass again. For many years the pastures have been admired by grassland experts and by farmers. Adequate winter food is grown based on approximately 16 acres of roots and 8 acres of an arable silage crop. One real difficulty, however, is caused by the heavy demands of the hill flock during late winter and spring, but it is hoped that the policy of reseeding on the hill will in time overcome this problem. Strict attention is being devoted to general management; in fact most of the conditions conducive to a good flow of milk would appear to have been created, but without achieving the full results expected. In a letter from a Dorset producer in the March, 1949, number of the *Home Farmer*, attention was called to the curious fact that the milk yield suddenly drops when the herd grazes certain fields. At the College Farm it has sometimes been our experience that, when turning the herd into good aftermath, and expecting more milk as a result, the yield has dropped markedly. Is this due merely

to overeating? It may be mentioned that the disappointing results from grass occur mostly in July and August, even when there is no drought.

A significant feature of the herd is the readiness with which they put on flesh, and at the end of their lactations the cows are in prime condition—even relatively high yielding cows exhibit this characteristic.

It has been thought, therefore, that a possible reason for the tendency to put on flesh at the expense of milk, is that there may be some substance, such as a specific hormone, or one affecting hormone balance, present in the food given, particularly the grass.

The discovery by Australian workers of the sex hormone in some samples of grass, and its important effects on animal metabolism is an indication that this supposition may not be unreasonable and that there may be a problem to be explored. There is a belief long held by practical men that certain farms are suitable for milk production, and others for meat. The scientist considers that provided the grass is young, and that the protein is sufficiently high, it should give equally good results for either meat or milk. There is a possibility that a climatic factor is involved—perhaps the amount of sunshine. Phillips at Aberystwyth has started interesting investigations with reference to calving dates, and it may well be that the amount of sunshine during the year can also be an important factor in making grass suitable or unsuitable for milk production.

Bangor Investigation Much of this is only interesting speculation, and it was felt that the performance of cows purchased from high-producing herds, particularly from the east, might provide some guidance. Would such cows, for example, yield as well at the College Farm as in their previous lactations in a different environment? Again, would the shape of the lactation curve be dissimilar?

With these questions in mind, five cows—four Shorthorns and one cross-bred—were purchased from herds in the East Midlands and South of England. Two cows were bought newly calved, and three cows just prior to calving.

Milk Yield (in lb.) of Five Purchased Cows

No. of Lactations	Cow No. 1	Cow No. 2	Cow No. 3	Cow No. 4	Cow No. 5
	days	*days*	*days*	*days*	
1st	7,890 (288)	8,306 (300)	8,369 (315)	8,475 (273)	
2nd	8,412 (200)	9,332 (259)	9,211 (256)	8,284 (283)	
3rd	9,171 (252)	10,962 (273)	7,251 (237)	9,216 (270)	12,502 (280 days)
4th	10,334 (305)	8,492 (270)		9,744 (266)	
5th		10,214 (273)			

Cow No. 5. was a cross-bred, and no records are available for her first and second lactations.

The above table shows the performance of the cows since they entered milk production; the most recent lactation of each cow is that completed at the College Farm. All five lactations were completed during the latter part of September or early October, 1949. Only in the case of cow No. 3 was there a decrease in yield. The yields obtained from the other three cows clearly show that their previous production was more than maintained, and although figures for cow No. 5 are not available, the yield of 1,250 lb. is very satisfactory. The lactation curve of the five cows was plotted against the curve of five home-bred cows, calving at the same time, but apart from a significantly larger volume of milk from the former, no difference in the shape of the curve was evident.

A MILK YIELD PROBLEM

One matter raised earlier was that cows in the herd showed a marked tendency to put on flesh. Unfortunately it was not possible to weigh the purchased cows, but judged by eye there was a clear indication that they had gained considerably in weight by the end of their lactation. Cow No. 5 for example, was in rather poor condition when she calved, but as her lactation progressed she filled out considerably.

At this stage of the investigation, it would appear that cows with good records, and calving in early winter, can maintain those yields for at least one lactation. It would not appear, therefore, that the view that there is something present in the food supply which inhibits milk production, or that there is an unfavourable climatic factor responsible, is so far substantiated. In connection with the climatic factor, it is, however, worth mentioning that the conditions of the summer of 1949 in the west were much more like those normally experienced in the east and south. Sunshine records have been high, rainfall low, and the typical lush green pastures were never in evidence —yet, surprisingly enough, the cows on the whole milked well.

It is possible, therefore, that a different set of climatic conditions, or calvings at different times, would have produced different results. Clearly the investigation must be followed up before any definite conclusion can be drawn.

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THE VITAMIN B CONTENT OF GRASS

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THE existence of an anti-neuritic vitamin—later to be named vitamin B—has been known since the pioneer work of Eijkmann in 1897. Realization that the anti-neuritic factor, now known as thiamin, was only one member of a group of vitamins, has come only in comparatively recent years. In addition to thiamin, a deficiency of which results in beri-beri in the human, the so-called vitamin B complex contains riboflavin, nicotinic acid, pantothenic acid, biotin, pyridoxine, folic acid, and the anti-pernicious anaemia factor B_{12}. Deficiency of certain of these vitamins is known to produce serious consequences in man, and all are probably necessary for his well-being.

There is some evidence that the B vitamins are just as necessary to farm livestock. It is commonly believed, however, that the ruminants, at least, need not be fed on diets containing the vitamins, by reason of their ability to synthesize them in the rumen. Hence, very little attention has been given to grass as a source of vitamin B, and information on the subject is scanty.

A close examination of the literature shows that evidence for the synthesis of certain of the B vitamins by ruminants is by no means conclusive, and the assumption that dietary sources are unimportant may be ill-founded.

Moreover, there are non-ruminant farm livestock which subsist to a greater or less extent on grass, and which possess only a limited capacity for the synthesis of B vitamins, or lack it altogether. There is, for example, no good evidence that the horse can synthesize any of these vitamins other than nicotinic acid. As deficiencies of riboflavin, and probably of pantothenic acid have been produced experimentally[1], and as thiamin deficiencies are induced under field conditions in cases of bracken posioning, it would appear that the horse has need of some B vitamins which it is incapable of synthesizing. Hence the possibility of a deficiency of one or other of the vitamins developing in horses which are wholly on a grass diet cannot be ignored until the potency of grass is established.

Importance to Pigs and Poultry A dietary supply of the B vitamins is probably of greater importance to pigs and poultry than to any other classes of farm livestock. It is not unusual for pigs, e.g., breeding sows, to be run out on grass, and artificially dried grass is occasionally incorporated in proprietary pig meals. In the former case supplementary rations of some kind will be fed, and the possibility that this ration may, in certain circumstances, be short of the B vitamins, must at least be considered. For example, a supplementary ration which consisted largely of maize and/or barley, might well induce deficiencies in nicotinic and pantothenic acids if the remainder of the ration happened to be poor in these vitamins. The possibility of a prepared pig meal being dependent on a small percentage of artificially dried grass for the vitamins referred to, may be remote, but it could happen. It would therefore seem that a knowledge of the amounts of the B vitamins in grass would be of value in rationing pigs, more especially in the event of a new era of cheap maize.

There are at least three of the B vitamins which merit consideration by the poultry nutritionist. A deficiency of riboflavin in the ration can and, under practical conditions, sometimes does cause trouble. With chickens, the disease known as curled toe paralysis, which is characterized by nervous symptoms and poor growth, may ensue, while in breeding stock there is decreased egg hatchability and yield, with loss of bodyweight. The cereals commonly fed to poultry are markedly deficient in riboflavin, and birds kept intensively are dependent on supplementary foods for their supply. Yeast, liver meal and lucerne meal often constitute these supplementary foods, and as the first two at least are expensive and scarce, the efficacy of artificially dried grass meal as a source of the B vitamins is of some importance. The occurrence of deficiencies of biotin and pantothenic acid in poultry under practical conditions is a matter for conjecture ; the fact that we have not seen any record of such occurrence in this country is no proof to the contrary. Indeed deficiency in either of these vitamins would seem to be a distinct possibility ; there is plenty of evidence that maize, wheat and barley frequently contain insufficient biotin to meet recognized requirements of the hen while recent work by Bondi, Etinger and Meyer[2] suggests that maize and wheat are no better sources of pantothenic acid. Here again, it is desirable that the supplement, which may be lucerne meal or an artificially dried grass meal, should be capable of making good the deficiencies of the remainder of the ration.

Grass Examined The results of work recently published by the writers[3] does provide some information on the value of grass, when cut at the pre-flowering and hay stages, as a source of vitamins of the B complex. Investigation at the pre-flowering stage was made on individual

species of grasses, clovers and herbs, and at the hay stage on meadow swards under varying manurial treatment.

The grasses in general are no more than mediocre sources of thiamin but, as compared with the cereals, contain decidedly useful amounts of riboflavin. It is interesting to note, however, that four of the fescues, reputedly inferior grasses, are better sources of thiamin than either perennial ryegrass or cocksfoot. Moreover, the two grasses which contain most riboflavin are crested dogstail and red fescue. The pantothenic acid content of the grasses is very variable, but it would appear that some, including one or two of the better grasses, would not of themselves be capable of supplementing a deficient diet. Grass in general is not a very useful source of nicotinic acid or of biotin ; ryegrass and crested dogstail provide an exception in the case of the latter vitamin. The pyridoxine content varies from species to species and, although never outstandingly high, it is generally at a useful level. One or two curious and notable facts emerge from these findings. Reference has already been made to the superiority of certain of the poorer grasses in thiamin and riboflavin ; it should also be noted that cocksfoot has proved to be poorer than almost any of the species examined—grasses, clovers or legumes—in each of the B vitamins determined.

It was of particular interest to find that the leguminous plants examined (alsike, trefoil, lucerne and sainfoin) were, as a group, superior to the grasses as sources of riboflavin, pantothenic acid and biotin, the three vitamins which are known or believed to be of importance in poultry nutrition. It should be added that lucerne was markedly superior to any other of the legumes in pantothenic acid. These legumes proved to be rather mediocre in respect of thiamin, nicotinic acid and pyridoxine.

The herbs examined (yarrow, plaintain, burnet and chicory) were all found to be good sources of thiamin, being superior to the legumes and to all but one or two of the grasses. If it be added that these herbs contained useful amounts of pyridoxine, little more need be said about them. Chicory is relatively strong in both nicotinic and pantothenic acids, and burnet in pyridoxine.

Samples of grass taken from the swath on eleven selected plots of the Palace Leas meadow hay field at Cockle Park, in 1946 and 1947, were used for the determination of B vitamins at the hay stage. The effect of curing was investigated in samples taken from pikes on the same plots in 1947. As is well known, these classical plots have received different manurial treatment over many years. Briefly, it may be said that the results obtained showed no evidence that such treatment had any effect, adverse or otherwise, on the B vitamin content. Large and significant differences were shown to occur between the amounts in the 1946 and 1947 cuts. With the exception of biotin, all the vitamins were present in less amount in 1946. These differences are almost certainly due to the different character of the two seasons. The fact that biotin, which is less easily extractable from plant material than any of the other B vitamins, was present in approximately the same amount in the hay of both seasons, indicates that the other vitamins were leached by rain in the wet summer of 1946. The effect of curing appeared to fall unevenly ; while thiamin, pantothenic acid and pyridoxine suffered losses, the amount of nicotinic acid increased slightly. Riboflavin and biotin were unaffected. The losses sustained by the first three were anticipated, as they are unstable to light ; they could not be attributed to leaching, as in 1947 no rain fell between cutting and piking.

Pasture Provision If there was no evidence whatsoever that grazing stock of any class ever suffered from deficiency of one or other of the B vitamins, it would be pertinent to ask whether the potency of a sward in respect of these vitamins was of any importance. Some such evidence does in fact exist([4]), and this being so, it would seem sensible to make sure, in so far as it may be practicable, that any sward for grazing shall contain reasonable supplies of the B vitamins. The results which have been discussed suggest that this desideratum will not be attained by the sole use of those grasses which are conventionally regarded as "good". For example, stock grazing the most modern of leys are unlikely to have a very large supply of dietary thiamin. As has been shown, certain of the "poorer" grasses, and some of the "herbs," are particularly good sources of the vitamin, and it is no remote possibility that this fact may have something to do with the occasional preference which grazing stock show for rough and apparently inferior herbage.

The precaution suggested above would seem to be even more necessary in the case of swards to be cut for artificial drying. A considerable proportion of the dried grass produced in this country is used for the feeding of small livestock and, as has been shown, poultry in particular have need of a dietary source of the B vitamins. The results of the writers' work suggest that a ley which is to be cut primarily for this purpose, while having a useful clover content, should not contain a superabundance of the better grasses ; a large proportion of cocksfoot, for example, may not be conducive to a high riboflavin content.

The practical importance of a good B vitamin content in hay is less certain than in grass for drying, but it may be worth remembering that in a wet season heavy losses of all components other than biotin are probable. The normal curing process involves losses which fall unevenly on the complex, some of the vitamins being much reduced and others unaffected.

Finally, it may be noted that varying manurial treatment, largely with fertilizers, though it might be expected to affect the B vitamin content of a sward through changes in the botanical composition, does not, in fact, appear to do so. There is thus no support here for those protagonists of the humus school who maintain that the use of fertilizers is detrimental to the nutritive value of the crop.

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MARGINAL LAND

4. WALES AND THE BORDER COUNTIES

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IN this article marginal land concerns, primarily, ploughable areas mainly on the lower uplands which are, in their present condition, units of low production and which, for various reasons, demand more labour, fertilizers, etc., than normal farm land to transform them into units of reasonably high production. Once reclaimed, such areas can be maintained in good condition at a profit to the farmer and as a valuable source of food to the nation. Most farmers who have tackled such land during recent years would agree that the job has been worth while financially. Most marginal land presents some special difficulty such as bracken infestation, blocked drains, poor fences, inaccessibility, steepness, etc., and although the picture of dereliction which was a feature of the landscape in 1939 has been appreciably modified through the good work of enterprising farmers and War Agricultural Executive Committees, there is still abundant room for improvement in every county.

Altitude is relative because soil conditions in particular vary appreciably; whereas the average plough-line in parts of West Wales may be as low as 700 feet because of thin soil, rocky outcrops, etc., in parts of mid-Wales, and the eastern border, there is fairly deep soil at 1,000–1,100 feet and rotational farming is a common feature.

There are, of course, regional systems of farming in Wales, but on upland marginal land there is greater restriction in this respect than on the lowlands. The climate makes these areas suitable for the raising of livestock. Hay and pasture are the main crops. Oats and forage crops such as broadcast rape and turnips and, to a less extent, kale, are grown, as well as roots and potatoes. Before the outbreak of the second world war there was a considerable increase in grassland dairy farming, and this expansion was not confined to lowland farms. The nation's call for milk during the war led many upland farmers on marginal land to produce milk under difficulties. Whereas in the past these upland marginal areas were primarily concerned with cattle and sheep rearing, there are numbers of farms today producing milk as the main source of income. Reference has already been made to some of the factors affecting production on marginal land. An adequate supply of available plant food and lime is the first essential; that is, fertility must be raised. Most Welsh soils in their natural state are deficient in phosphate and lime. There is ample evidence to show that surface applications of fertilizers and lime can increase yields; where incremental dressings of nitrogen are used in addition to phosphate and potash, if needed, the increased yields have been appreciable. These results indicate that low production is in part due to a shortage of available plant food. Chemical evidence shows that there is an acute need of lime on large areas.

It has been found, however, that production may still be low for some years unless more productive grasses and wild white clover are introduced. To do this effectively the plough should be used wherever possible. Native herbage has naturally a short growing season; it is late to start growth in spring and it does not produce much in the autumn. It is by thorough cultivation, liming and manuring, good management, and pioneer cropping where needed that production becomes at all comparable in nitrogen and mineral content with that found on well-farmed lowland.

Soil Types The main elements forming the soils of Wales are derived from two primary sources—weathering of the underlying rocks themselves *in situ*, and the weathering of the superficial drift material from these rocks after the retreat of the Great Ice Sheets. In the first category there are four major groups:

1. *Cambrian Ordovicial and Silurian Rocks.* Soils formed by the weathering of these Lower Palaeozoic rocks occupy nearly two-thirds of the total area of Wales, and are found west of a line joining the Vale of Clwyd and the Vale of Towy. They are hard sedimentary rocks comprising slates, grits and sandstones, which weather into silicious soils. In exposed places, where drainage is bad and rainfall excessive, peaty soils are common.
2. *Old Red Sandstone Rocks.* Soils formed from old red sandstone rocks occupy a triangular area in South-Eastern Wales and the Border—Shrewsbury (north) to Haverfordwest (west) and Gloucester (east). They are of two kinds: (a) where the rock consists mainly of hard red sandstone and conglomerates giving high moorland country, e.g., Brecon Beacons; (b) where the rock consists of comparatively soft red marls which result in low-lying land with warm, fertile, reddish soil.
3. *Carboniferous Rocks.* Cutting across the old red sandstone triangle lies the pear-shaped carboniferous basin of South Wales. There is also a small outcrop east of the Vale of Clwyd in the North. The soils derived from them vary from poor quality formed from the limestone and millstone grits to those of fair quality from the sandstones and shales of the coal measures themselves.
4. *Newer Rocks.* Soils derived from the newer rocks (secondary and tertiary) form the sea plains of the southern margin of the Principality—South Pembrokeshire, South Gower and the Vale of Glamorgan. Most of these rocks give light, good loams of a kind not found elsewhere in Wales. In many ways they are representative of the English lowlands.

DRIFT SOILS. The second category consists of drift soils. It must be stressed that no statement on the soils of Wales can be complete without emphasizing the importance of the drift soils. Most of the valley floors are alluvial, but some of them and the sides are smeared with glacial boulder clay. This gives a stiff, heavy clayey soil, often well mixed with stones. In the wetter parts of the country the drift tends to be waterlogged and to give rise to acid humus and to acid, peaty soils. In brief, the climate causes a heavy leaching of all soils.

Some Examples of Improvement *Hendre Hall Farm, Llwyngwril* (*Messrs. Parry Bros.*). This farm, situated on the Merioneth coast and rising sharply as rough grazings from sea level to 800 feet, is fairly typical of conditions in north-west Wales on Ordovician shales. The soil, thin and gravelly, is very stony. The "ffridd" or "intake" (400-600 feet) is steep, while the rough grazings (600-800 feet) are strewn with boulders. It was possible to plough the intake (approximately 30 acres) with an ordinary two-furrow plough; the rough grazings (about 27 acres have been ploughed), although not so steep as the "ffridd," needed a prairie buster. The boulders were collected together and built up to provide shelter for stock. It is intended to complete the ploughing of one block of rough grazings (about 7 acres) this year; the remainder is unploughable.

Both before the war and now the farming policy has been concentrated on dairying and sheep. The farm comprises roughly 64 acres arable and grass (about 20 acres level); 33 acres "ffridd"; 96 acres rough grazings; 50 acres mountain.

The "ffridd" and rough grazings before improvement were infested with bracken and gorse. The usual practice before reseeding has been to grow rape and turnips as successive pioneer crops. Ground limestone and fertilizers have been used generously.

Stock numbers in June, 1943, and June, 1949, respectively were as follows:

	1943	1949
Cows and heifers	10	11
Ewes	340	308
Other sheep and lambs	410	422
Other cattle	—	21

The average annual yield of milk over a period of years has not varied appreciably. For some years, however, the herd has been fed almost entirely on home-grown food and the yield per cow has been well above the average. Stock numbers of dairy cows, ewes and lambs have shown little variation from year to year. The average carcass weight of lambs, however, has increased since 1943 from 24 lb. to 30 lb. a head. Furthermore, whereas up to 1943 about 100 ewes were wintered away, now the whole flock remains "at home". The wool clip is heavier and lamb losses are fewer; there are fewer culls. The greatest change, however, between 1943 and 1949 concerns other cattle on the farm. In 1943 none was purchased: in 1947 and 1948 between 20 and 25 were bought in the autumn as two-year olds or over, overwintered cheaply on the farm and sold later in the year. In 1948 they were sold fat. The dry summer of 1949 created difficulties in fattening. In addition to the normal farm complement of lambs, 120 and 140 respectively were purchased in 1948 and 1949 and fattened. The undertaking has shown a satisfactory financial gain to the two brothers.

Bailey Bevan, Llanyre, Llandrindod, Radnorshire (*Mr. D. Davies*). A large block of marginal land on boulder clay starts to the east of Llandrindod and runs westerly to the county boundary at the river Wye. The district is wet, cold and late, and the land is very difficult to cultivate. The top soil varies from 3 to 5 inches deep, the clay subsoil being greyish-yellow to grey in colour. Where drainage has been neglected production is very low. Owing to the cohesive nature of the land, tile or pipe drainage systems need to be comprehensive. Lateral drains are rarely more than 10 yards apart. Except for a very small acreage on most farms retained more or less as permanent arable, the land has been in grass for many years prior to the outbreak of war. Many farmers in the area have increased their livestock production considerably during the last ten years.

The example here discussed gives an indication of what can be achieved where the drainage system is efficient and the lime and fertilizer requirements are adequately maintained.

Bailey Bevan is a mixed store cattle and sheep farm on boulder clay at about 700 feet above sea level, in a 45 inches rainfall belt. The present owner-occupier took over twenty years ago. At that time the farm of 90 acres—made up of 55-60 acres arable and grass and 30-35 acres of marginal land—carried 19-20 head of Hereford and Hereford-cross cattle of all ages and 30 breeding ewes. By 1938, after a few fields had been tile drained and ploughed, there were 21 acres of tillage land. The rotation was corn; roots and potatoes; corn and seeds (5-7 year ley).

By 1939 the cattle (all ages) had increased in number to 26 and the breeding ewes to about 50-60. The quantity of concentrates purchased had now been cut by about 50 per cent. Since 1939, 27 acres of the marginal land (rental about 4s. per acre) have been reclaimed, of which about 13

acres have been thoroughly drained. The rotation used on this land was similar to that on the grass-arable block. There remain about 7 acres of unimproved marginal land, which it is intended to tackle as soon as possible. In 1948-49, 33 cattle (all ages) were wintered on the farm. Sixty-two cross Kerry ewes are kept, and these are mated to a Shropshire ram.

The trend during recent years has been to buy-in stores in the autumn at 1½ years old for overwintering and selling at a fair profit at 2½ years. Previously more calves were reared and stores were sold at 1½ years old. The small quantity of concentrates purchased today is used mainly for calves. It is worth noting that all the reclamation work, including draining, has been carried out by the farmer himself with a little occasional help. This is an excellent example of individual effort and understanding of the conditions.

Vale and Pantymaes, near Brecon (Mr. Davies). These two contiguous farms on old red sandstone, managed as one unit, range in altitude from 750 to 1,150 feet above sea level. Out of a total of 470 acres there were, in 1939, 260 acres rough grazings (1,000-1,150 feet) and 40 acres of woodland. During the period 1940-49, 100 acres of rough grazings were brought into production through ploughing for pioneer crops—broadcast rape and turnips—and then reseeding. In their unimproved condition they were thickly infested with bracken, some gorse and scrub, and as such they were poor grazing units. The general procedure has been to plough a certain acreage in January to February. Lump lime and basic slag at 30 and 10 cwt. per acre respectively were applied before sowing rape and turnips.

In the following spring a 4-5 grazing ley was sown on a well-rolled, disced surface, without ploughing. The method proved entirely satisfactory, good takes of seed being obtained consistently. The number and type of stock on the farms in 1939 and 1949 respectively were as follows:

Stock	1939	1949
Cows and heifers in milk	15	35
Calves	15	47
Other cattle	29	21
Total cattle	**59**	**103**
Breeding ewes	350	310
Other sheep	506	386
Total sheep	**856**	**696**

Where cattle were used for grazing and a further dressing of phosphate was applied to the ley in the second to third year, there was no reinfestation of bracken. Where, through lack of water, it was not possible to graze cattle effectively and reliance had to be placed on sheep, bracken tended to regain ground. Before improvement a typical block of 20 acres was practically valueless, but as a new ley the same area carried 35 cows with their calves for six months, after allowances were made for short rest periods. Normally sheep graze the leys from early winter to mid-February, when they are rested for cattle grazing later. At 4-5 years old the leys are ploughed and put through a short rotation before reseeding a second time.

During the ten-year period under review there has been a change in policy in regard to sheep. In 1939 the sheep were Welsh-Cheviot crosses with an average lambing percentage of 80. The income from sheep was dependent on the sale of draft ewes, fat and store lambs. Today the farms carry Clun crosses with concentration on fat lamb production. The ewes are sold fat when broken mouthed. Lambing figures today approach 150 per cent and the carcass weight is 40 lb., as against 30 lb. in 1939. Last autumn rye was sown in order to do the ewes with twin lambs as well as possible. There has also been marked improvement in the condition and quality of the cattle kept on the farms. The in-calf cows are all outwintered. Cattle are sold as stores usually at 12-15 months old. This year a bunch of 15 bullocks realized

£40 10s. a head. There are still 40-50 acres of these rough grazings capable of improvement by ploughing, etc., and reseeding, and the programme to bring them into cultivation is well in hand.

Mr. Davies considers that the policy he has adopted is economic under present conditions. The results indicate what can be achieved even at a relatively high altitude. Examples of such enterprises are numerous on similar soil types in mid-Wales and the Border Counties. Inaccessibility and lack of water may be limiting factors on many farms, but there is still a large acreage where the plough can be brought to work profitably without great difficulty. The plough, pioneer crops, lime, fertilizers and reseeding, coupled with the introduction of more cattle on land now grazed almost exclusively by sheep, can step up production per acre considerably on marginal land of this type.

Cwm Risca, Tondu, Bridgend (*Mr. Richards*). This farm, approximately 300 acres in extent, is situated on the coal measures in South Wales, at an altitude of 500-700 feet above sea level, and was taken over by the present occupier twenty-three years ago. At that time the total stock comprised 15 head of cattle and 75 Welsh Mountain breeding ewes, brought by Mr. Richards from a semi-upland farm of 70 acres which he occupied previously. This number of stock then seemed sufficient for Cwm Risca. By 1939 an appreciable acreage had been ploughed, cropped and reseeded. The policy on the rough hill land was to plough preferably in July, when the bracken which dominated it was in full growth. Heather was a common constituent on the fields nearer the farmhouse. As a pioneer crop it was usual to sow herbage seeds (two-year ley) under rape. At the second ploughing, suitable fields were ploughed for oats, then roots (potatoes and/or swedes) to be undersown in the following year under oats. Fields which were unsuitable for rotation work were at the second ploughing reseeded to a long duration ley, 5 to 7 years, under oats. It was soon apparent that satisfactory results were not possible without generous dressings of lime, and for several years it has been customary to apply lime, usually annually, and generally as lump lime. Lime has been applied on the high land, both with the pioneer mixture and again as a light dressing when reseeding under corn.

Phosphates, potash and nitrogen fertilizers have also been applied fairly generously. Yields of 9 tons per acre of potatoes have frequently been obtained, and this is the only crop not utilized on the farm.

The stock figures in the June, 1949, returns were as follows :

Cattle		Sheep	
Cows and heifers in milk ..	22	Breeding ewes	210
Cows and heifers in calf ..	15	Rams	7
Service bull	1	Other sheep	222
Cattle over 2 years old ..	2	Horses	5
Other cattle	19	Poultry	83

As production from the farmlands increased, the breed of sheep has been changed gradually to a heavier type.

In the autumn, early winter cattle are folded on rape and, in recent years, to some extent on kale. Silage (grass and arable), hay, crushed oats, barley and roots contribute to the ration after Christmas. Rape and/or kale are sown following ploughing ; after harvesting, arable silage or an early hay crop and the land reseeded in the following year under oats or oats and barley mixture. Some of the sheep are fattened on leys and rape, some on roots, while some may be sold as stores. Six to twelve acres are reseeded annually. During the present occupancy practically all the farmland has been brought into some form of rotation following the plough—only two fields remain unploughed. As the figures indicate, stock numbers have increased almost

fourfold; the stock also make better growth of good quality, while the mild yield per cow is well above the average. The policy of improvement has been closely linked with building up and maintaining fertility.

Lime, phosphates, nitrogen, catch cropping (including undersowing corn with Italian ryegrass), full utilization of leys and the intelligent use of almost all available home-grown foodstuffs, with an adequate water supply and laid on electricity, have all contributed to stepping-up production on this farm.

Improvements similar to these described have been carried out on a large number of farms in Wales. In fact a tremendous acreage of marginal land has been brought into cultivation during the last decade. Even on these farms still more can be done, and generally this is intended as part of the future programme. From the farmer's point of view, any policy of improvement is naturally linked with economics, building facilities, etc. and, of course, personal interests. Insofar as national policy is concerned, the use to which the improved lands are put might not necessarily be the best, but the urgent need is for more and better food per acre. In this respect, the pioneer work already done has helped materially. The aggregate evidence shows that a substantial increase in production can be brought about profitably on many more holdings in suitable situations on similar soil types. The precise methods to adopt in order to reach the objective may vary from farm to farm and between one district and another, but whatever the plan soil fertility must be built up to a high standard and maintained.

At Cwm Risca it has been the practice to sell cows at the second or third calving in full profit, the farm relying itself largely on heifers. At the Vale, Breconshire, there has been a changeover from hill farming to a semi-lowland system. The evidence from Hendre shows that the lower uplands can be used effectively for overwintering the ewe hoggs. This is extremely important, since lowland is becoming more difficult to obtain for the purpose. Fertilizers do not function effectively on waterlogged soil; a large acreage of rush-infested lowland is marginal because drains, at one time efficient, are now blocked. What has been achieved on the boulder clay land in Radnorshire can be effected much more easily on many acres of kinder land at a lower elevation. Marked improvement can be obtained in many cases without any elaborate drainage schemes. The need for sensible rotations with adequate periods of rest as well-managed leys is strongly revealed from observations made over a wide range of country. The seeds mixtures used for marginal land must be equal to requirements. High-tillering, leafy strains are essential for maintaining satisfactory production on the longer-duration leys.

Although this article has dealt mainly with upland marginal land rather than its lowland counterpart, rush-infested lowlands, in particular, call for immediate treatment. The tendency to concentrate on the drier land both on the semi-uplands and on the lowlands is to be deplored because here, provided surplus water can be carried away effectively, there is often a reserve of fertility which is invaluable. There are thousands of such neglected acres which, unless tackled properly, and early, will revert to bog.

The general methods to use to improve these lands are known but there will be limited resources for the complete conduct of the work. For this reason, most farmers would carry out their improvements gradually by handling a small acreage annually. The need for more production and better utilization, so vital to the national larder, requires that everything possible should be done to bring about suitable improvements.

THE MANAGEMENT OF BLUEFACED LEICESTER FLOCKS OF SHEEP

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This is the second of two articles on the Bluefaced Leicester. The first, which appeared in last month's issue of AGRICULTURE, dealt with the history and characteristics of the breed.

THE majority of pure-bred flocks of Bluefaced or Hexham Leicester sheep are found in South Northumberland, usually on farms where a breeding flock of cross-bred, grassland ewes is also a feature of the farming system. The size of the Leicester flock seldom exceeds 40 ewes and generally varies between 10 and 30. Most flocks have been established on good lowland farms in the Tyne valley, although some are located at higher elevations and one, at least, is situated on land at 1,000 feet above sea level. Management is broadly similar to that of the cross-bred flock. Differences arise from the fact that with the pure flock the farmer is specializing in the production of rams for sale while, with the cross-bred flock, he is simply breeding lambs for slaughter. Management of the pure-bred Bluefaced Leicester flock naturally varies according to farm conditions, but the following description is generally applicable.

Breeding Policy An appropriate starting point is the beginning of the breeding year, i.e., autumn. The number of breeding ewes kept on any farm normally remains fairly constant. Therefore each year draft ewes are sold to make way for new animals. In cross-bred flocks kept for mutton production, the usual reasons for drafting are loss of teeth and unsound udders. Selection is not so straightforward in the small pure-bred flocks, where the owner knows well how each individual sheep has bred during the previous year. Old, "broken-mouthed" ewes may be retained if they have proved good and consistent breeders, while young and active ewes may be culled if their progeny have proved disappointing and if the owner is satisfied that the fault rests with the ewe. Ewe lambs and gimmers are also culled if they are not of suitable type.

Stock rams are normally bought at two main sales held in Hexham. The first, for shearling and older rams, takes place in September, while ram lambs are sold at a special sale a fortnight later. The purchase of suitable rams provides the best means of flock improvement, and buyers look for animals possessing characteristics lacking in their own ewe flocks. A most important point to be considered when choosing a ram is the type of fleece desired. The amount of wool a sheep grows depends upon its breeding and the environment in which it is reared. Soil formation, in particular, is known to have considerable influence on wool growth. Thus sheep which would have light fleeces on some farms may grow heavy fleeces on others and vice versa. If a breeder is aware that his farm grows strong wool, he may buy a ram with a fine, light fleece, knowing that the progeny from such a ram will grow a stronger fleece under his particular conditions. The pure breeder of Bluefaced Leicester sheep is catering for the buyer of rams for crossing with hill ewes, and the type of sire in greatest demand for this purpose is known to change slightly from year to year. The breeder must therefore follow the sales closely and try to buy stud sheep which, when mated to his own ewes, will breed ram lambs likely to meet the future demand.

Stock rams are not bought on appearance alone. Animals offered by reputable breeders, and perhaps sired by notable rams, meet the keenest demand. Some breeders attempt to improve the prepotency of their own

strain by mild inbreeding, and very often a breeder will buy successive rams from the same flock. This practice, however, is not continued for more than three or four generations, as many breeders fear that constitution may be impaired by too close inbreeding. In some of the larger flocks a promising ram lamb may be test-mated with a few ewes before being used more widely as a stock ram in later years. Because of this, young rams which are known to have been used for one year in pure-bred flocks and then offered for sale, are viewed with suspicion. On the other hand, aged rams that have been used for several years in pure-bred flocks, and are noted as good stock-getters, command high prices.

Since flocks are small, it is a quite common practice for two or three breeders to share the services of one ram. Alternatively, two or three good ewes from one flock may be sent to run with a neighbour's flock at tupping time. In this way, breeders whose small flocks do not justify the purchase of high-priced rams, can ensure that ewes are mated to good sires.

Mating Rams are usually run among the ewes at the beginning of October, which means that lambing starts in early March and continues until early April. The ewes need to be in good condition when put to the ram, but they are not intentionally flushed, because the breed is naturally prolific and large numbers of lambs are not favoured in ram-breeding flocks. Rams are usually "keeled" (raddled) so that approximate lambing dates are known. The colour of the keel is changed at the end of three weeks, after which any ram of poor fertility can be detected. If two rams are used they are keeled with different colours, and in some flocks ewes are drawn out each week as they are tupped and given a distinctive mark. Order of lambing is thus known and progeny by different sires can be identified.

Grass provides all the nutrients required by the ewe flock until December. The precise date when supplementary foods are introduced depends upon the condition of the ewes, the amount of grass available, and the weather. When the weather turns colder and little grass is available, hay is given in covered racks, and swedes may be led out to the sheep at pasture, allowing 2-4 swedes per ewe, or 5-10 lb. per day. A little trough food, usually crushed oats, is offered from the beginning of January. If the ewes are troubled by liver fluke they are dosed with carbon tetrachloride pills during the winter months. Dosing once, twice or more times may be necessary, according to the severity of the attack.

Lambing Bluefaced Leicester lambs are rather poorly covered at birth and are very liable to perish if born outside during inclement weather. They have not the vitality of cross-bred lambs which soon struggle to their feet and suck. For these reasons most breeders bring the ewes inside to lamb. Ewes and lambs go out to pasture during the day and, depending on weather conditions, are kept inside for one or two nights after lambing. Many twin lambs are born and triplets are fairly common. No ewe is allowed to rear more than two lambs, and attempts are always made to transfer a lamb from twins or triplets to a ewe that has lost its progeny. When there is a choice between a ewe and ram lamb for fostering, the ram lamb is always left with the mother so that it suffers no setback and benefits from the increased share of milk.

Management after lambing depends very largely upon weather conditions and grass growth. Fresh grass fields, that have not been grazed by sheep for some time, are preferred, but such land is scarce. If the grass has not begun to grow, hay and root feeding must continue, and mangolds are a specially

popular food for stimulating milk production at this time of the year. The feeding of concentrates is continued in any case, and ewes will receive approximately 1 lb. per day.

In flocks where losses from lamb dysentery are known to occur, serum inoculation of lambs at birth is practised to induce immunity to the disease. Similarly, if losses from pulpy kidney disease have taken place in the past, lambs are inoculated with pulpy kidney serum at 2-3 weeks old. All lambs are docked at 3-4 weeks. The dosing of lambs with phenothiazene and/or copper sulphate-nicotine to counter parasitic stomach worms is now a routine practice on almost every farm. Such treatment is particularly important with ram lambs, which must be unchecked if they are to be well grown by the autumn sales. Flocks are dosed in June and at least once again during the summer months.

Clipping and Summer Management Shearing takes place in June, and lambs are weaned in July when 14-16 weeks old. After weaning, the ewes are moved to a poorer field to discourage milk secretion, and weaned lambs are given the best of grazing, preferably out of earshot of the ewes.

Management after weaning depends very largely upon the age at which rams are sold. On the more exposed farms, where lambing dates are retarded, lambs are too small for sale in their first autumn. Here, breeders generally consider that it is better to winter them and sell as 18-months-old shearlings. On more favourably situated farms, all, or almost all, are sold as ram lambs at the October sales. The latter practice permits more breeding ewes to be kept and gives a quicker, as well as a larger, turnover.

Management during the summer months varies according to which of these two selling policies is practised. When intended for sale as shearlings, the ram lambs receive no special treatment during their first summer, and are run with the ewe lambs after weaning. On the other hand, rams intended for sale as lambs (and other sheep entered for agricultural shows) receive special feeding ; usually the best aftermath is reserved for them and concentrates are offered from early August. The standard of shepherding must be very high during this period if the ram lambs are to appear at their best on the sale day. Blowflies can be serious pests during hot, thundery weather. The shepherd tries to prevent "strikes" because, even when a sheep receives immediate attention, there is discoloration and loss of wool, which spoils the animal's appearance for sale purposes. In this connection repeated dipping during the summer with DDT preparations is a great help. Lameness, chiefly due to foot rot, is another source of trouble which must be avoided, as lame sheep never thrive and are a menace during the mating season. Regular paring of the hoof and frequent foot bath treatment usually gives good protection.

Some strains of Bluefaced Leicester are very bare over the crown of the head, which, because of irritation by flies and consequent rubbing, may be disfigured by unsightly sores and scabs. In flocks where this trouble is encountered, Stockholm tar is used as a repellent and a special cap is sometimes fitted to protect the crown of the head.

Autumn Sales Breeders naturally aim at having their ram lambs or shearlings in good condition for the autumn sale. As the buyer requires rams for turning out on the hills, sheep which are excessively fat, through having received too liberal supplies of concentrates, are not wanted. Such pampered animals lose condition quickly on hill land and

mortality can be high. Rams for sale are usually dipped in an ordinary yellow paste dip which gives a slight tinge to the fleece, but the bright orange colour seen on Border Leicester sheep sold at Kelso and elsewhere is not favoured. Before dipping prior to sale, surplus wool is removed and sheep are usually trimmed slightly. Owing to the absence of a long, heavy fleece, faults of conformation cannot be camouflaged.

Ewe lambs and ram lambs which are to be sold as shearlings are summered on average pasture with no supplementary feeding. The sexes are separated as mating season approaches. It is not usual to mate ewe lambs, since experience has shown that lambs from such matings are too late and too small. Ram lambs may run with the ewe flock after the mating season, and they benefit from supplementary winter feeding given to the ewes. Ram and ewe hoggs are clipped earlier than the ewes. After shearing, the rams destined to be sold as shearlings in the autumn are managed on lines similar to those already described for autumn-sold ram lambs. The ewe hoggs or shearling gimmers are summered on average pasture and join the ewe flock in the autumn.

Constitution The chief criticism levelled at the breed today is its lack of constitution. This is indicated by a high mortality rate when rams are used under adverse conditions. Indeed the narrow-chested, weak type is still too much in evidence. But by using better sires and by more rigorous selection, breeders are endeavouring to produce sheep of stronger constitution. In recent years one breeder at least has attempted to improve size and consititution by outcrossing with a Wensleydale ram. First-cross progeny showed better size, weight and hardiness, but possessed coarse coats and showed too much wool on the face and neck. These ewes have been mated with a very fine-woolled Bluefaced Leicester ram, and if such a breeding policy proves successful the Wensleydale may be used again at intervals. The majority of breeders, however, do not approve of this policy and are striving to increase size and hardiness by the slower process of selection within the breed.

METHODS OF APPLYING FERTILIZER TO POTATOES PLANTED BY MACHINES

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THE normal method of fertilizing and planting potatoes has for long been to ridge up the field, apply fertilizer broadcast over the ridges and then plant the potatoes by hand in the furrows, splitting the ridges to cover the seed. The splitting of the ridges concentrates the fertilizer over and around the seed, where it will be in the best position for efficient use by the growing plants.

A recent survey of maincrop potatoes in England showed that a quarter of the acreage sampled was planted by machine. Also, it is known that the number of potato planters has increased rapidly in recent years and that over 7,000 were in use in England and Wales in 1948. Most of these modern potato planters are designed to work on flat land, planting the seed and covering it over with a ridge of soil. The problem of how fertilizer can be applied most efficiently when such machines are used must be of interest to many farmers and their advisers.

APPLYING FERTILIZER TO POTATOES PLANTED BY MACHINES

Four Methods Contrasted at Rothamsted

From 1945 to 1947, a series of experiments* was carried out to determine the best way of applying fertilizer to potatoes planted in the furrows of ridged land. Although in these experiments the potatoes were planted by hand, the results give some guidance on the most suitable methods of manuring potatoes planted by machine. A brief description of these experiments and their results will therefore be given first.

Powdered National Compound Fertilizer No. 1 (average composition 7 per cent N, 7 per cent P_2O_5, 10.5 per cent K_2O) was applied at approximately 5, 10 and 15 cwt. per acre by four methods:

1. Fertilizer was broadcast on the land before it was ridged up for planting.
2. Fertilizer was broadcast evenly over the ridges before planting.
3. Fertilizer was placed in the bottom of the furrow in a band so that after planting it would be in contact with the seed.
4. Fertilizer was placed by means of a special machine in two bands, each 2 inches below the bottom and 2 inches from the centre of the furrow.

The average yields of the unmanured plots and the increases given by fertilizer in fifteen experiments in 1946 and ten experiments in 1947 were (*in tons per acre*):

Year	Mean Yield without Fertilizer	Fertilizer per acre	Mean Increase in Yield from Fertilizer			
			Broadcast before ridging	Broadcast after ridging	Placed in contact	Placed as sidebands
		cwt.				
1946	6.8	5	1.2	1.9	2.4	2.0
		10	2.8	3.6	3.5	3.7
		15	3.5	4.3	4.5	4.0
1947	7.1	5	0.9	1.5	1.7	1.8
		10	1.8	2.2	2.4	2.4
		15	2.4	2.7	2.1	2.8

These results show that broadcasting before ridging was inferior to other methods of applying fertilizer. About 15 cwt. of fertilizer broadcast before ridging were required to give the same yield of potatoes as 10 cwt. applied by any of the other three methods after ridging. This was true both in the wet year (1946) and in the dry year (1947). Placement in sidebands gave about the same yields as broadcasting after ridging. The results from placing fertilizer in contact with the seed varied both with the amount of fertilizer and with the season. The results were good for all rates in the wet year, but in the dry year of 1947, in which there was much hot weather and little rain after planting, the heaviest dressing of 15 cwt. of fertilizer per acre placed in contact with the seed checked growth and gave low yields.

It appears from these figures that when potatoes are planted in the furrows of ridged land, whether by hand or by machine, there is no advantage to be gained from special placement methods; the best method of application is to broadcast the fertilizer over the ridges before planting. It is not possible to do this however, with machines which work on the flat and which have no special fertilizer attachment. With such machines, no other course is possible than to broadcast the fertilizer on the flat before planting—a method which the experiments have shown to make inefficient use of the fertilizer. To secure an equivalent yield of potatoes, considerably heavier dressings must be applied on the flat than are needed on ridged land.

*G. W. Cooke. Placement of Fertilizer for Potatoes. *J. Agric. Sci.* 1949, **39**, 96.

Use of Fertilizer Attachments Planting machines with fertilizer attachments allow better use to be made of the fertilizer. Most British machines with such attachments place the fertilizer in the planting shoe quite close to the sets. This method may be entirely satisfactory for moderate dressings, but it cannot be recommended for dressings heavier than about 10 cwt. per acre of compound fertilizer of ordinary strength, as there is risk of injury to sprouting on light soils, on poor seedbeds, and in dry seasons. Farmers using such machines should be aware of the dangers of applying heavy dressings in this way. The risk is increased with mechanisms which deliver fertilizer unevenly and at different rates from those indicated by the settings on the machine; some rows or parts of rows may thus receive excessive amounts of fertilizer. Possible remedies are to check the rates and uniformity of delivery, to arrange the delivery tubes in such a way that the fertilizer falls ahead of the planting shoe, or, best of all to broadcast part of the fertilizer before planting, and to apply, say, only 5 cwt. per acre through the planting shoe of the machine.

This discussion of the results of the experiments shows that if the most efficient use of fertilizer is to be obtained from machines planting on the flat, the attachment should place the fertilizer in bands 2 inches to the side and a little below the sets. Such machines are used in the United States, but as far as is known, no machine of this type is yet on sale in Britain.

MECHANIZED POTATO PLANTING

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So far, mechanized planting has not caught on in the main potato-growing areas (Lincs and Isle of Ely) to the extent one might expect, probably because no great difficulty has yet been experienced in getting sufficient labour for planting. Even so, there farmers who look to both ends of the job; and they hold the view that it is sound policy to engage hand labour for planting, as the gang may be employed on other work throughout the summer and be available for lifting the crop at the end of the season. In districts new to large-scale potato growing the labour position is not so favourable, and it is here that there has been a fair demand for mechanical potato planters. It is likely, however, that mechanized planting will spread to the main potato-growing areas with the introduction of a planter, capable of dealing efficiently with chitted as well as non-chitted seed.

Chitted Seed Potato growers in the County of Holland favour the planting of chitted seed, since they are satisfied that such seed produces earlier and much bigger yields. Indeed farmers in this area have spent thousands of pounds on chitting houses and trays, and consequently they are rather chary of machines which damage the chits.

Unfortunately, there is a small body of opinion in the country that holds there is no advantage in planting chitted seed, and that no damage is done to the sprouts when seed is tipped into the hopper and allowed to gravitate to the feed basket. On the contrary the advantages obtained by planting chitted seed have been proved by both practical and experimental work. Injury to the sprouts can occur in a number of ways—rough handling and dumping the trays of seed, severe jolting in transport, and by tipping chitted seed into the hopper. Inspection of any hopper into which

chitted seed has been tipped will show that a large proportion of the sprouts are knocked off. Further, a fair percentage of sprouts are so damaged that they die after planting.

There are several machines on the market with mechanism suitable for planting chitted seed, but only one specifically designed for carrying chitting trays.

Spacing It should not be assumed that machines with semi-automatic planting mechanism will space the tubers accurately in the row at any pre-determined distance. Spacing may be affected in a number of ways, particularly by irregular feeding of the planting mechanism by an indifferent or tired operator, and by travelling too fast and so forcing the rate of planting.

When planting, the potato has a tendency to roll in the ridge, due to any of the following causes: (1) the height above the ridge bottom at which the planting mechanism releases the potato; (2) the shape and angle of the planting chutes; (3) the shape of the ridge bottom; (4) smoothness caused by planter wheel tracks on the ridge bottom, especially with pneumatic tyred wheels; (5) whether the sets are placed or dropped into the ridge; (6) the time lag between releasing and covering the tubers; or (7) the type, angle and setting of the covering bodies.

Spacing will be improved by conscientious operators and fatigue reduced by changing the team or giving the operators a break. The planter should also be allowed to travel at a reasonable speed.

The covering bodies should be pouring soil on the tuber immediately it is in the ridge bottom. This may be done by taking the covering bodies or discs forward and closer to the planting chutes. Carry out the following mechanical checks: see that the right sized sprocket is fitted for the required spacing distance; correct the tension of chains and belts driving the planting mechanism; and with mounted machines adjust the ground drive wheel correctly.

With hand-operated machines employ conscientious operators. Check spacing with the timing of the clicker wheel by making a run on the surface before starting to plant.

In mechanized potato planting trials at Kirton, it was found that the percentage of potatoes planted in a band 2 inches on either side of the pre-determined spacing were as follows:

	per cent
Hand planting	66–85
Hand-operated planters ..	35–50
Semi-automatic planters ..	28–62

From these figures it will be seen that hand planting, as practised by gangs in the Fens, shows the better spacing. Spacing by hand-operated planters varied with the length, angle and shape of the planting chutes, the better spacing being the work of a machine fitted with "short" vertical, square, planting chutes. Of the semi-automatic planters, only two showed an accuracy of spacing above 50 per cent, which indicates that the mechanical release of the potato into the ridge does not ensure even spacing. Fully automatic planters did not, and cannot be expected to, show favourable spacing results until seed is closely graded for size.

Fertilizer Application American experiments have shown that concentrating the fertilizer in bands on either side of the potato is the best method of application, but so far similar results have not been obtained under our conditions. However, we have ample

THREE ROW PLANTERS

Photos, *Farmers' Weekly*.

Left : Lincolnshire demonstration of machine designed and equipped for planting chitted seed.

Right : A machine with a well-designed and constructed fertilizer attachment.

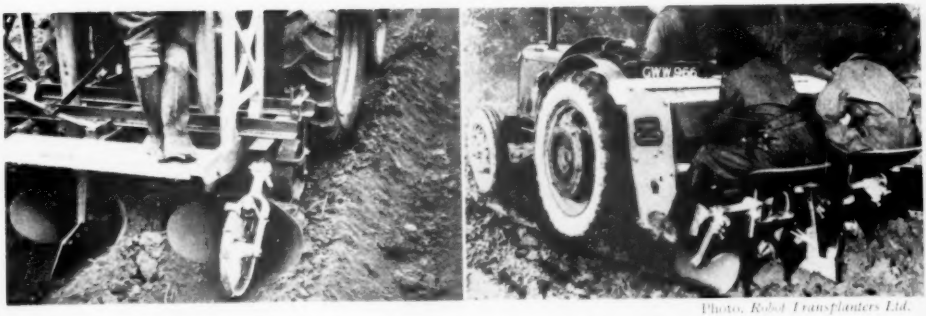
TWO ROW PLANTERS

Photo, *Farmers' Weekly*.

Left : Hand-operated planter, adapted for carrying chitted seed.

Right : Semi-automatic model modified for carrying chitting trays.

JOINS



Photo, *Robot Transplanters Ltd.*

Left : Tractor with wheels *correctly adjusted*, allowing wheels to travel along bottom of outside ridge, thus ensuring regularity of joins.

Right : Tractor with wheels *incorrectly adjusted*. Note driver steering tractor on land; result uneven and irregular joins.

Direct Reseeding. Hereford Cattle on five-year-old sward at 1000-1200 feet.

Crop of S.84 Oats at 1100-1200 feet.

Reclamation of Bracken Land at 1000-1100 feet.

1st Year: Rape and turnips (middle background); 2nd Year: Oats (foreground); 3rd Year: Usually reseeded under rape.

Close-up of Reseeding under Rape (third stage) after Oats.

BROCCOLI MOSAIC (See pp. 577-9)

Affected leaf
showing vein clearing.

Affected leaf
showing mottling.

a

b

Effect of frost on (a) a healthy plant ; (b) a plant
affected with broccoli mosaic.

practical and experimental evidence to show that the best results are obtained when the fertilizer is placed close to the growing tuber, as is achieved when the fertilizer is applied in the ridges for hand planting, or with planters which operate on ridged land.

With combination machines or planters with fertilizer attachments, either of the following methods may be adopted: (a) all the fertilizer may be applied in the ridge with the potatoes at the time of planting, in which case there is a serious danger of the sprouts and growing sets being scorched, especially when quantities above 7 cwt. of fertilizer per acre are applied; or (b) to avoid such injury many growers broadcast half to two-thirds of the fertilizer on the surface before working the land, and the remainder down the spout when planting.

There are two main points in favour of fertilizer attachments: (1) the whole job of ridging, fertilizing, planting and covering is completed in one operation, and (2) the application of fertilizer may be more economical when placed in the ridge with the potato. But against this must be set the practical consideration that operators thoroughly dislike handling fertilizer when planting; planting speed is reduced as the result of time spent on the headlands filling the fertilizer hopper; fertilizers corrode the mechanism and so cause rapid deterioration; and with most machines there is difficulty in securing an even or accurate rate of distribution.

On the whole, machines with fertilizer attachments fail to give satisfactory results, unless dry or granulated fertilizer is used. Indeed it is by no means uncommon to find farmers who have discarded the fertilizer attachment after the first season.

With planters which operate on the flat without fertilizer attachments, all the fertilizer must be applied on the surface of the soil, and well worked in when preparing the land for planting. With this (broadcast) method of distribution many growers are of the opinion that it is necessary to increase the quantity of fertilizer per acre by 50 per cent, e.g., for every 10 cwt. applied in the ridge, 15 cwt. should be distributed on the flat. Where fertilizer is broadcast and worked in some several inches deep, depth of planting is an important factor especially in a dry season such as 1949, when there was every indication that seed planted within the fertilizer level gave the best results.

Covering and Joins The method of covering at the time of planting is of the utmost importance when the fertilizer is broadcast on the surface and planting is done on the flat. The short concave or straight breast, whilst bringing up a good ridge, tends to pull much of the soil which contains the fertilizer to the top of the ridge, where harrowing takes it down to the outside. The longer convex or general-purpose plough-type breast rolls or turns the fertilizer incorporated in the top layer of soil over and around the tuber. When covering is done with discs, ridging looks anything but a pretty job, and worse still, when the discs are set at the wrong angle, there is a tendency for the tuber to be carried forwards and upwards. But when the discs are at the correct angle, the few inches of top soil and fertilizer are gathered over and around the tuber, so, it is considered, influencing early growth and a possible increase in yield of several tons per acre.

Many farmers believe that it is absolutely necessary to use a three-row planter, to facilitate inter-row cultivations with standard three-row equipment. It is true that a competent tractor driver working a three-row planter on the flat will secure a high degree of regularity in joins, but there are others who find difficulty in following the marker trail. Whereas with

a two-row planter working on the flat with the wheels properly adjusted, e.g., 56 inches (two 28 inch rows), the tractor wheels travel along the bottom of the outside ridge, so that with ordinary driving care, joins are automatically regular and subsequent inter-row cultivations with three- and four-row implements can be carried out with ease.

Last spring we carried out a number of checks on work done by two- and three-row planters. It was found on putting the tape across twenty rows at a time, that three-row machine work showed a variation (either gain or loss) of 3 and more inches. Against this, the work done by the two-row machines with the tractor wheels correctly adjusted showed only 1 inch variation in twenty rows, or near enough 100 per cent regularity of joins.

Rate of Working The aim of mechanization is to economize in labour, reduce costs, or increase production. Mechanical planting may save labour, but from the information we have been able to obtain it does little to reduce costs. So far as increased output is concerned, i.e., in terms of chains per hour, or acres a day, the whole question depends on the human element and tractor speeds. Tests at Kirton have shown that the maximum rate at which operators can handle sets varies with the type of planting mechanism and the operators' working position on the machine. With the radial feed and erect seated or comfortable working position, an operator can handle approximately 110 to 120 unsprouted sets per minute.

With the lateral feed and crouched working position, considerably less can be handled. Moreover, after several hours operators show signs of fatigue and complain of backache. Whether the planter is hand operated or semi-automatic, the efficiency of planting is measured by evenness of spacing, freedom from misses, and absence of doubles.

As far as tractor work is concerned, speeds present an important problem. To plant an acre an hour with a three-row planter, a tractor speed of $1\frac{1}{6}$ miles per hour is required. But since turning on the headlands, loading with trays, and perhaps fertilizer, must be allowed for, the rate of travel must be at least $1\frac{1}{4}$ m.p.h., which is above the maximum speed at which operators can handle sprouted seed on 14-inch spacing. It is essential that tractor speeds should be kept low, and this is the difficulty, since wheel-tractors do not usually have a bottom gear less than about $1\frac{1}{2}$ m.p.h. and crawlers about 1 m.p.h. The only way to cut down speed is to have a low governor setting, but with reduced engine speed it is not always possible to get the steady pull which is necessary for even planting.

The emphasis, however, should not be on acres per hour but on *yields*, and it is for this reason that farmers should give adequate attention to the problems of mechanical planting.

BROCCOLI MOSAIC

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BROCCOLI MOSAIC is common wherever broccoli is grown extensively in Britain; it is particularly prevalent in Devon and in East Kent. In these areas it causes serious losses annually, and it is not uncommon to find 75 per cent or more of the broccoli in a field infected—many of them so seriously that they are worthless. The disease also occurs commonly in private gardens and allotments all over the country and, although it has been recognized for many years, it seems to have become more widespread recently.

A Virus that Affects all Brassicas Broccoli Mosaic is caused by a virus* that can affect all kinds of brassicas. On most types it does not produce much visible effect, but on cauliflower and broccoli it causes a serious disease. Broccoli plants infected with the virus develop a "mosaic," or pattern of light and dark green on the leaves, the plants remain small and produce small heads which are easily damaged by frost. The symptoms of the disease on cauliflower, sprouting broccoli and some forms of kale are similar, although the effect is less severe. Brussels sprouts, cabbage, kale, rape, savoy, swede turnip and turnip are all readily infected, but the symptoms produced are often slight and generally pass unnoticed; the plants are, nevertheless, reduced in vigour.

The virus is not transmitted through the seed or soil, and so seedling plants are healthy to begin with. Infection is brought to them by winged aphids (greenfly) which feed on infected plants and then fly to the seedling bed. Several kinds of aphid can transmit this virus, but those most usually responsible are the cabbage aphid (*Brevicoryne brassicae*) and the peach-potato aphid (*Myzus persicae*). In feeding on the infected plant, the aphid imbibes virus with the plant juices and later injects some of this virus into the young healthy plants on which it feeds. The virus multiplies inside the young plant and so produces the disease, symptoms of which begin to appear in about three weeks.

Symptoms The first symptom of the disease in broccoli and cauliflower is what is known as "vein-clearing" (the leaf veins become translucent and stand out more clearly). Vein-clearing, however, is difficult to see and is easily confused in the field with injury resulting from insects feeding on the leaf. Afterwards the veins become yellow, and the later-formed leaves develop a pattern of light and dark green. This often takes the form of dark green bands, up to a quarter of an inch or so in width, along the veins, with light green or yellow areas between. Sometimes these bands do not develop, and, instead, the leaves are mottled light and dark green all over. Typical leaves from broccoli plants with mosaic are shown on p. iv. of art inset.

In cold weather mosaic or vein-banding develops about six weeks after infection has occurred, but if the weather is warm the appearance of symptoms is delayed. Normally, therefore, if a plant is infected in early summer, the heat of July and August prevents the development of symptoms and no signs of mosaic are seen until the autumn. In autumn, after a period of cooler weather, all the leaves of a broccoli plant infected in early summer are

* The Cauliflower Mosaic virus.

mottled, the plant is slightly smaller than normal, and the central leaves are very small. Such a plant either produces no head at all, or only a small, useless one. Before any symptoms have appeared, however, the disease has been spread to many other plants by aphids flying or crawling from the plants infected early in the year, and this spread continues throughout the autumn. A plant infected in late summer shows normal outer leaves and mottled central ones in the autumn, and will produce a small head. The outer leaves on infected plants fall with the first frosts, and the central leaves remain small and fail to protect the developing curd. If, therefore, frost occurs after the heads have begun to form, those on infected plants will almost certainly be destroyed.

The loss caused by Broccoli Mosaic is thus twofold: plants infected early in the season produce no head, and plants infected later form small heads which are unusually liable to frost damage. Late infections are of comparatively little importance in early varieties, but cause serious losses in late varieties. The early infections, however, are more important because they produce the greatest direct damage and because it is from them that the later infections usually spread. Early infections occur when the plants are still in the seedbed, and the best time to take precautions against the disease is when the plants are in the seedling stage.

Preventive Measures With cauliflower raised under glass or in frames, special care should be taken to keep the young plants free from aphids by fumigating or spraying carefully with nicotine at regular intervals. Any old brassica plants close to the houses (or frames) should be destroyed.

Where broccoli or cauliflower are raised in the open, infection in the seedbed can be reduced in a number of ways. As infection can be brought in afresh to each new seedbed from infected plants in previous crops, every effort should be made to remove the previous year's brassicas before the new seedlings appear. Stumps should be composted or burned, and old plants, if suitable, may be fed to cattle. If plants or stumps are ploughed in, care should be taken to ensure that they are completely covered with soil. It will usually be possible to get rid of Brussels sprouts, kale, savoy and winter cabbage in this way before the new season's broccoli is sown ; early broccoli and overwintering turnips, swedes and rape should be destroyed similarly.

It is, however, often necessary to sow the new season's broccoli before the later types of broccoli from the previous year can be cleared. In addition, if spring cabbage is grown, or if any brassica plants are kept for seed, these will still be on the farm when the new seedbed is prepared. In such cases the seedbed should be placed as far away as possible from the old plants in order to reduce the danger of spread of infection from the old plants to the new. The growing of brassicas for seed is best avoided in a broccoli area, however, because of the danger of infecting young plants. Siting seedbeds near allotments and gardens should also be avoided, and co-operation between neighbouring farmers may be necessary to obtain the maximum isolation of the seedbed. It should be *at least* 200 yards from any brassicas, and a much greater isolation is advisable where possible.

Infection is usually greatest at the edges of a bed, especially in the shelter of a hedge or bank. Broccoli seedbeds should therefore be put in the middle of a field, clear of banks and hedges. It is wise, also, to surround the bed with a few rows of cabbage, kale or rape seedlings. Much of the new infection will then be absorbed by these protective rows, and the broccoli themselves will be correspondingly freer from infection. The cabbage or other seedlings

in the protective rows are best ploughed in when the broccoli are planted out ; if they are saved for planting they should be put in a different field from the broccoli.

If the aphids on *old* plants can be controlled by fumigation or spraying with nicotine in the spring, the migration of winged aphids to the seedbeds will be limited and thus the spread of infection to them reduced. In practice, this is difficult because the weather in spring often does not allow nicotine to be used efficiently. Control of aphids in the seedbed is scarcely worth while, for it is unlikely to prevent infection from reaching the bed, though it may reduce any secondary spread of infection within it.

Some cruciferous weeds can be artificially infected with the virus and may at times be a source of infection for broccoli. Actually this had not yet been proved, but as a precautionary measure, headlands and other ground close to broccoli seedbeds should, as far as possible, be kept clear of cruciferous weeds (charlock, shepherd's purse, Thanet weed, etc.) especially in the early months of the year.

The roguing of affected plants is not an economic or effective way of controlling Broccoli Mosaic. Symptoms are not usually visible until autumn, and thus infected plants cannot be identified until it is too late for roguing to have much effect.

All varieties of broccoli and cauliflower are easily infected, and although some are a little less seriously affected than others, there are no known resistant or immune types.

Summary of Recommendations The procedure recommended where Broccoli Mosaic is troublesome may be summarized as follows :

(1) Destroy as many as possible of the previous year's brassica plants before the new season's broccoli seed is sown.

(2) Put the seedbed as far as possible from any brassicas which cannot be destroyed.

(3) Place the seedbed in the middle of a field and surround it with kale, rape, or cabbage seedlings.

These steps, if carefully carried out, will normally give satisfactory control of the disease. If they are not successful in any area, farmers should consider modifying their crop rotations for a year, so that the farm is *entirely* free from all types of brassica for at least a month. This can sometimes be done by having seedling plants raised in another area where broccoli are not grown and brought in when required for planting out ; alternatively it may be necessary to leave broccoli out of the rotation for a year.

TRACTOR FUEL ECONOMY

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ECONOMY in the use of fuel on the farm helps self-sufficiency in just the same way as saving feedingstuffs. Tractor fuel is not one of the major items of expenditure in farm accounts, for £50 covers the annual cost of petrol or vaporizing oil for most medium-sized tractors engaged on ordinary farm work. Nevertheless, small savings can often be made with little trouble.

Losses can occur during the storage of the fuel on the farm, and there can be wastage through spilling the fuel while pouring it into the tank of the tractor. There can also be leakage from the tractor tank, pipes and carburettor. But most waste comes through imperfect combustion of the fuel in the cylinders of the engine, and from losses of energy in the transmission of the engine power from the rear wheels of the tractor to the implement being operated. There can in addition be serious losses due to inefficient loading of the tractor.

Storage of Fuel The most convenient way of storing tractor fuel is in an underground bulk storage tank with a hose delivery pipe. Moreover, the capacity for accepting a large quantity of fuel at each delivery from the supplier enables some fuels to be bought at a bulk price which is considerably lower than the aggregate cost of several small deliveries. The tank and pump should be sited so that the tractor can be brought to the pump without being driven along the yard or a metalled road—this is important when the tractor has to be used with spade-lugged wheels—but the opening to the storage tank must be against a roadway hard enough to bear the tank lorry which brings the bulk supply.

Bulk storage tanks do, however, involve quite appreciable capital expenditure, and in some circumstances they may not be considered worth while. Storage in drums and cans is likely to continue on many farms. Where this method is used, any cans or drums that have become battered until the fuel can seep through their rims should be discarded or repaired, and a large funnel should be used for filling the tractor tank from the cans. If ordinary two-gallon petrol cans are employed, it is important that the can, when being emptied, should be held with its opening uppermost, so that the air replacing the fuel can flow steadily into the can.

Aids to Saving Fuel Once the fuel is in the tank, it must be made to yield as much useful power as possible. It is sometimes possible to save fuel by changing the standard setting of the carburettor, and no doubt an operator who is prepared to give some thought to the problem, and to take extra care in driving, can sometimes hit on a more economical setting. Usually, however, it is best to accept the manufacturer's setting or, if the jet is an adjustable one, to control the carburettor in accordance with the manufacturer's instruction, for it must be remembered that a very weak mixture, though it may give a low fuel consumption, can bring with it such troubles as burnt exhaust valves which can be expensive to put right.

The greatest savings of fuel are, however, achieved, not by intricate engine tuning, but by skilful management of the actual operations of the tractor. In this "science of tractor management" we can include adjustment of the load to suit the tractor's capabilities, and the avoidance of idle

running. We can include also the elimination of losses of fuel due to difficult starting and inefficient running caused by some electrical or mechanical defect in the engine, and losses due to poor wheel grip.

The first point to remember in considering loading is that much of the energy given by the engine is used to transport the tractor and implement, and that a basic amount of fuel has to be used whether the implement is doing a good, heavy job or a light one. Therefore, the size and adjustment of the implement should be such as to make full use of the capabilities of the tractor. If the tractor seems underloaded, then a wider bout of work should be attempted or, if the kind of operation allows it, the tractor should be run in a higher forward gear.

Wheel Slip At the other end of the scale we have to avoid giving the tractor a heavier load than it can comfortably manage. Overloading uses the engine at too near its maximum output and will cause it to wear out quickly. It is likely that overloading will also bring wheel slip, with consequent waste of fuel. Sometimes the slip is bad enough to bring the tractor to a standstill, but often a pneumatic-tyred driving wheel can be making many more revolutions than it need, without the slip being apparent to the driver. Wheel slip is a direct loss of power and therefore a direct loss of fuel.

It is worth while making a rough estimation occasionally to find how much the driving wheels are slipping when the tractor is dealing with a given load. First paint a mark on the wall of one of the tyres, or on the metal rim near the tyre; this will make it easy to count the number of revolutions of the wheel. With the implement in work the distance the tractor travels while the driving wheel makes ten revolutions is marked on the ground by pegs, and then measured. Next, the implement is unhitched (or is lifted out of work if it is a unit-principle outfit) and the tractor is run free in the same gear as before, and the distance of travel for ten revolutions of the driving wheel is measured again. The difference between these two distances, divided by the distance travelled without load, and multiplied by 100, will give roughly the percentage of slip. If the percentage is more than 18, then something ought to be done to reduce it, for fuel is certainly being wasted.

One way of reducing the slip is, of course, to reduce the load of work; but it often happens that wheel slip occurs long before the work load is great enough to put a full demand on the engine. In such cases, if the grip of the driving wheels can be improved, the tractor will be able to deal with a heavier load more economically. Indeed, improving the grip of the wheels can sometimes actually relieve the engine by reducing the loss of power due to the rolling resistance of the wheel passing over the ground. When tyres are slipping so much that they are on the point of digging in, their rolling resistance often becomes so high that the engine is stalled. The grip of the driving wheels can be improved by adding ballast or by fitting strakes to them.

Spade-lugged steel wheels rarely slip seriously without digging themselves in, and calculation is rarely necessary. Moreover, an inspection of the impressions left in the soil by the lugs of the wheels when the tractor is pulling its load will give sufficient guide to whether any excessive slip is taking place. If the impressions retain about the same shape as the lugs which have formed them, then the wheel is gripping satisfactorily; but if the imprint is much enlarged there is too much slip. The grip of steel wheels can also sometimes be improved by ballast to cause deeper penetration of the lugs

into the soil. A frequent cause of slip is, however, worn spade lugs; as well as losing their total length for penetration, the worn lugs become rounded instead of wedge shaped.

When the driving wheels are gripping well, the driver must avoid taking undue advantage of their grip by increasing the load to such an extent that the engine is overworked. With a little practice and thought, he will be able to judge this by listening to the rhythm of the engine; when the speed of the engine seems to have been brought down and the exhaust note indicates that the engine is labouring, the driver should reduce the load or change to a lower gear.

Take Care of the Engine Keeping the tractor engine in good order is a sound step towards making the best use of tractor fuel. Leaking valves or gummed piston rings can cause the engine to consume much more fuel than is warranted by the output of power, and faults in the ignition system can make the engine difficult to start. Difficult starting, which in the case of a vaporizing oil engine often involves emptying and refilling the carburettor chamber several times, wastes fuel directly, and it can waste it indirectly by causing the driver to keep the engine running while he is loading a trailer or adjusting his implements.

Altogether it can be truly said that good tractor maintenance, and careful management to avoid idle running and inefficient loading, can make a worthwhile contribution towards a high standard of farming by ensuring full value from every gallon of fuel.

APPLE ORCHARDS GIVE VARYING YIELDS

A. H. HOARE

National Agricultural Advisory Service

FEW crops of economic importance give such varying yields as the apple. The reason for this is attributable partly to certain adverse qualities inherent in the crop plant itself. For example, in some varieties, owing to pollen incompatibility or a polyploidal condition, infertility occurs, and in others a marked tendency to biennial fruiting develops. With apples, as with most of our cultivated fruits, the crop plant is always a clone*, and therefore, unlike seeded crop plants, any crop improvement through the plant is an impossibility. The apple grower has to accept the clonal variety as originated by nature, and once it is adopted for extensive cultivation the grower can only take effective measures to prevent any deterioration that may result from infection by plant viruses. Amongst fruit plants, mainly strawberries, raspberries and blackcurrants, viruses are a strong deterioration factor. The apple, however, is not entirely immune from such deterioration, an example being seen in the "rubbery wood" condition that occurs in the variety Lord Lambourne.

The main causes of the varying yields of apple orchards are frost, attacks by pests, pollen incompatibility, bad pollen, lack of suitable cross-pollination, deficiencies of major and minor nutrient elements, and biennial fruiting.

* Clone: A term introduced in 1903 by Dr. H. J. Webber of California, to signify progeny derived by vegetative propagation from one original individual. In horticulture, in contradistinction to agriculture, clonal multiplication takes a leading place.

Apart from these major factors, orchard cropping is affected to some extent by the age of tree, the rootstock used, the method of pruning, spraying efficiency, and soil management. As regards the last-named factor, orchards crop better, as a rule, under grass or some form of soil coverage (e.g., soiling crops) than under tillage; but sometimes cover crops give better results than permanent grass, other things being equal.

For economic production high average yields from apple orchards are vitally important, and their attainment should receive primary consideration. With apples, the marketing unit is the bushel—a measure of approximately 40 lb. weight. In commercial orchards, as a rule, the production cost per bushel is reduced as the yield increases. With apple growing, production costs in terms of overheads and interest, and maintenance charges for soil management, manuring, pruning and spraying, vary little from season to season. It would be false economy to attempt to cut down such items as spraying and manuring. Pruning, too, is usually a systematic treatment, and cannot be omitted from the seasonal routine.

The apple grower is in precisely the same position as the grower of wheat or potatoes: his production costs are so much per acre and ultimately have to be considered in terms of cost per bushel or ton of crop. The question is: what should be the bare minimum average yield from established orchards to cover the grower's producton and marketing costs and provide some farm profit? Judging by experiences both in this country and abroad, the answer should be 200 bushels per acre. This is the figure suggested for growers in eastern U.S.A.(1) where the economics of apple growing have been studied for many years. (Very little attention has been given to the subject in this country.) Accepting, then, this figure of 200 bushels per acre as a bare minimum, we can say that as the yield increases above this figure, so will the cost of production per bushel decrease and the profit increase.

Little Reliable Data Very little reliable data regarding the cropping of commercial apple orchards are available. Presumably, growers have these figures for their own orchards, but they do not publish them. Any information concerning the cropping of standard varieties of apples has hitherto been available mainly from the annual reports of research stations and from papers published by research workers.

At present, an attempt to obtain definite information regarding yields of apple orchards in south-east England is being made by the Department of Economics at Wye College. A preliminary report dated September, 1949 (2) contains some interesting observations on the subject of apple yields generally, and on the factors affecting tree performance in terms of cropping. Perhaps the most interesting of the sets of figures given in this report are those relating to the yields for an identical sample of seven farms (361 acres of apples) over a five-year period (1944-48), because they give individual average yields for five leading dessert varieties and five leading culinary varieties, as well as the total average yields for *all* dessert varieties and *all* culinary varieties for the same period. In addition to the yearly and total averages, the tables give the range of yield each year for each variety.

Two points of interest from this report are (1) that the risk of a complete crop failure appears (from the figures collected) to be higher with dessert apples than with culinary apples, and (2) that the tendency to biennial bearing of certain varieties is probably the most important single factor affecting yield. This tendency does not, as a rule, operate arbitrarily, but is related to such influences as weather conditions and previous season's cropping. Although the incidence of the biennial cycle is irregular, evidently the apple tree develops something of the nature of a fruiting rhythm. The point

of importance is that this rhythm is more pronounced in some varieties than in others. It is interesting to note the cropping figures for four acres of *Miller's Seedling* as illustrative of this biennial cropping habit:

Year	Yield per acre *bushels*
1944	72
1945	782
1946	194
1947	558
1948	152

Clearly, this variety had three "off" and two "on" years in the five-year period : the significance of this point is referred to later.

Although it would be unwise to draw firm conclusions from what is only a short-period investigation, the Wye College report throws some light on the commercial status of our standard market varieties considered in terms of crop yield. A longer period of recording is necessary, however, before definite views can be formulated. But an investigation of this kind is of special value because production data from an appreciable number of farms, presumably of varying soil and situation, are made available. During 1947 and 1948 the investigation covered twenty farms with an aggregate apple acreage of 1,230. Some really useful cropping data should be available when records for these twenty farms have been obtained over a six-year period. For evidently, in order to obtain a fair annual average figure, a period of six years is necessary because of the biennial cropping tendency—an important varietal behaviour factor which cannot be discounted.

Wide Cropping Ranges It was stated at the beginning of this article that few important crops give such variable yields as the apple. This variability is seen not only in total seasonal yields but in the seasonal range of yields of different orchards. Range of cropping figures are of interest because they serve not only to illustrate the degree of reliability of each variety but to show the extent to which the crops on individual farms diverge from the group average.

The table below gives the cropping-range figures for the five standard dessert varieties from the first and last year's recordings of the identical sample of five farms:

Variety	1944 *bushels*	1948 *bushels*
Cox's Orange Pippin	4–200	5–541
Worcester Pearmain	1–750	120–562
Laxton's Superb	0–308	164–391
Miller's Seedling	30–160	46–509
Beauty of Bath	0–17	24–310

The cropping figures recorded by the Wye College investigators indicate that crop failure is more likely to occur with dessert varieties than with culinary varieties. *Cox's Orange Pippin*, the best money-making apple, was a failure on at least one farm every year, a fact that will not surprise those who are acquainted with the vagaries of this variety. On the other hand, there is evidence that *Worcester Pearmain* can be classed as a "steady" variety, which is more reliable than either the temperamental *Cox's Orange Pippin* or the biennial-habit-forming *Miller's Seedling*, and the grounds for its popularity as a market-grower's apple are apparent.

In conclusion, the figures below, from the Wye College Report, give some indication of the behaviour of our standard dessert varieties in south-east England. The figures are taken from the Tables of records of the identical sample of seven farms over a five-year period. The consistently low yields for 1944 mark the fact that this was the worst year of this decade for orchard fruit crops.

Variety	Acreage Recorded	Lowest Average Yield	Highest Average Yield	Five-year Average
		bushels	*bushels*	*bushels*
Cox's Orange Pippin	98	61 (1944)	344 (1947)	207
Worcester Pearmain	54	74 (1944)	360 (1948)	290
Laxton's Superb ..	16	102 (1944)	438 (1946)	312
Miller's Seedling ..	4	72 (1944)	782 (1945)	352
Beauty of Bath ..	2	13 (1944)	337 (1946)	210

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FARMING IN CHINA

H. L. RICHARDSON

Dr. Richardson was Adviser to the National Agricultural Research Bureau of the Chinese Ministry of Agriculture from 1937 to 1943, and again in 1947-48. During his stay, he travelled widely and, with Chinese co-operation, directed a large programme of field fertilizer experiments, planned with the object of providing information about the fertility and nutrient deficiencies of Chinese soils.

MR. F. H. KING'S book *Farmers of Forty Centuries*,* the fourth edition of which has recently been published, is largely concerned with farming in China. The author went to the Far East from the United States of America conscious of a mission—to learn and proclaim the "Message of China and Japan to the World" in agricultural matters. So firmly was he convinced of the merits of this message that his account of farming in China and Japan is over-flattering; too much is made of the good points and too little of the bad.

Mr. King visited Japan, Korea and China as long ago as 1907—several years before the Chinese revolution. His visit was really a five months' tour; but although he saw, and recorded a great deal in the time, he could not travel extensively enough into the interior to obtain a fully representative picture. His book, however, was written with such charm and human sympathy that it has been reprinted frequently and has tended to displace far more authoritative books on Far Eastern agriculture that have appeared since—accounts by experts who have lived long and travelled widely in the countries concerned.

* Jonathan Cape, 15s.

Small Family Farms The average size of a farm in China is 4 acres (only about one-twentieth of the size of the average English farm), and in general one farm supports one family. The average size of a field is half an acre; the average area of cropped land per head of the rural population is also close to half an acre. The Chinese written character for "prosperity" is a picture of one mouth over a field: the English reader can judge for himself what level of prosperity this implies.

Although many Far Eastern farmers have a crude plough, drawn by an ox or water-buffalo, a great deal of the cultivation is done laboriously with heavy digging-hoes, or mattocks. The farming is chiefly arable, and the farmers' diet is largely vegetarian. There are some pigs and hens, and the flesh and eggs are mostly sold to the towns; any other animals are kept to provide labour, not food. The arable land is cropped to the limit, two crops commonly being taken in a year, or three crops in two years. The pressure of the population on the land is extremely heavy, and the average farm family, living on the bare minimum of land necessary for existence, is incredibly poor by western standards.

In spite of the proverbial industry of the Chinese peasant, he can put little by, whether in savings or in stored food. He is helpless in the face of natural adversities such as flood or drought. It can be stated that on an average throughout China, three severe famines have occurred in any area within any one man's life-time; each famine lasted almost a year, during which time 13 per cent of the population migrated and five per cent starved to death. The writer who inadvertently misquoted the title of King's book as "Famine of Forty Centuries" was not far from the mark!

Large Uncultivated Areas Though the pressure of population on the land is terrific, only one-fourth of the land area of agricultural China is cultivated. Three-fourths of the land is too poor, too hilly, or too severely eroded for even the industrious Chinese to be able to cultivate it continuously by traditional methods. Much of this land shows the signs of old cultivation; it has been farmed, exhausted, and abandoned, perhaps not once but several times during China's long history. Roughly half of this enormous area of uncultivated land is more or less productive in other ways, chiefly in growing trees, scrub, or coarse grasses used for fuel or manure or in providing a little rough grazing for working animals. Such rough grazing is usually concentrated near farms or villages, where overgrazing commonly occurs, accompanied by severe gullying.

Erosion, both sheet and gully, is widespread if not universal in China. The only hilly land which is kept under continuous cultivation is that which has been terraced in flattish steps—at an enormous cost of human labour—or that which is based on geological parent material which readily forms new soil despite erosion. Such are the loess soils of north China and the purplish soils in the "Red Basin" of Szechwan. A fraction of the soil material eroded from the hills is deposited on the alluvial plains; to this extent the farmers of eastern China benefit from the soil losses of west China farmers.

King made a great feature of what he called "permanent agriculture" in the Far East, but most of the farming he described was on alluvial plains. Permanent agriculture is found on alluvial plains in many parts of the world; in India, Egypt, Europe, and elsewhere. It is true that farmers in the Far East have gone a long way in restoring to the soil the nutrients removed by cropping, but there are inevitable losses which can be made up only from outside sources. On the alluvial plains fertility is maintained by the silt and soil carried by flood-waters. Where this source of supply is

lacking Far Eastern farmers have to depend upon whatever alternative supplies of plant food may be available in the neighbourhood.

In hilly regions and with ordinary soils, permanent farming is maintained only on valley bottoms or on terraced hillside fields, at the cost of partial destruction of the adjoining soils and vegetative cover. Both soils and vegetation are cut, carried to the fields, and burned or composted in order to provide manure. Even then, only a low to moderate level of fertility is secured and plant nutrient deficiencies are general. Eighty per cent of Chinese soils, tested in over 500 fertilizer field experiments, gave significant responses to added plant nutrients.

Because of such practices as the foregoing, practically all soil profiles in China, except those on level land, are "truncated". The original top soil has long been lost; what remains is subsoil, with a small proportion of humus. It is as a result of these destructive practices that the Chinese landscape has taken the form described by Cressey (in *China's Geographical Foundations*): "A land gnawed to the subsoil by the ceaseless effort of innumerable greedy generations, despoiled of all forest, cultivated to its last palm of earth, sapped of its vigour, yet where man is ever febrilely multiplying himself".

At this point the reader of King's book may wonder whom to believe: such a picture is almost the opposite of the one presented by him. It is as if he were describing a different country. To a great extent, King *was* describing a different country; namely, the one-fifth of agricultural China which lies on her fertile alluvial plains, and more especially the farm lands surrounding her large cities.

Farming Contrasts The towns and cities are the great sources of manure in China. There have been centuries, or rather millenia, of carrying food into the cities from the countryside, far and wide. For many centuries, also, human excreta have been carried back to the countryside—but mostly to the countryside more nearly surrounding the cities. As a result the plant nutrients from a wide area have been concentrated within a ring of some few miles around each city. These fertile rings are perceptible to the close observer as he travels over the Chinese countryside: rich soils and heavy crops warn him of the approach to a town, even before the buildings come into view. In the remote rural areas lies the other half of the story. Here the soils have been partially exhausted by continuous cropping without adequate replacement of plant foods, and nutrient-deficient soils are found even on the alluvial plains.

Thus the superficial observer or the hurried tourist, whose impressions of Chinese farming may be gained chiefly from rickshaw-rides into the country around a few of the big cities, will have an entirely false conception. His report on Chinese farming may be true, in a strictly limited sense, but it cannot be representative. It is likely, too, that much of what he sees will be either market gardening or a combination of market gardening with farming, because many farmers within reach of a Chinese city grow some vegetables for the market. Something like this evidently happened during F. H. King's journeys.

The foregoing must be said by way of a background to King's story. Provided this background of reality is borne firmly in mind, his book may be read with both pleasure and profit. The account he gives of the Chinese farmers and their households, the primitive way of living and the primitive tools employed—illustrated by many lifelike photographs—brings back vividly to one who knows it the sights (and the smells) of the countryside. King does not refer to the smells, but during certain seasons of the year when night-soil has been spread over the fields, they are most noticeable.

King seems favourably impressed by the large numbers of people who are supported by a square mile of land in China and Japan: he uses this as a measure of the productivity of Far Eastern farming. More truly, however, it is a measure of the poverty and the low standard of living of the farmers themselves.

Traditional Methods and Crop Yields It is where King describes and praises Far Eastern methods of maintaining soil fertility that most caution is needed. Some of the methods he describes, such as composting canal mud near Shanghai or making a dry-earth compost in Shantung, are quite localized. Over most of agricultural China the conservation of waste products is far less systematic or effective than one would imagine from reading King's book. The average rates of manuring, and the average crop yields that result, are much below the individual examples mentioned by King.

In considering crop yields per acre, it is necessary to be clear about the standard of comparison. Compared with India, where the soils have been exhausted by centuries of cropping without manure, Chinese yields are high. Compared with the U.S.A., which has large areas under extensive agriculture, they are tolerably good. But compared with the yields obtained by modern scientific agriculture, using intensive methods, in western Europe and elsewhere, Chinese yields are low. In Japan, where some modern improvements have been introduced—including a large consumption of chemical fertilizers—crop yields have risen during the present century to levels considerably above those obtained by traditional methods.

One of the great problems with the ancient, traditional methods of farming and manuring used in China is that of increasing productivity. Local resources are already employed to the limit, even at the cost of exploiting and destroying the uncultivated soils, so that to increase crop production further by traditional methods is like trying to lift oneself by one's own boot-straps. This was the experience during the Sino-Japanese war, when attempts were made to increase food production in blockaded China. Traditional methods represent a closed cycle of plant nutrients, and soil fertility can be raised only by bringing in more plant foods in the form of chemical fertilizers. This has been done in Japan in recent decades; it was begun also in China, but the war and the Communist advance have interrupted the process. It must be resumed there, if food production is to keep pace with the increasing population.

Use of Night-Soil The most serious criticism of Far Eastern farming methods—and one to which King makes curiously little reference—is based on the disease and death to which they give rise. The universal use of human excrement as manure results in the gravest pollution of all soils and water supplies. Far Eastern peoples have, by selection, built up some immunity to the diseases thus carried, but the selective process has to be repeated in every generation, and intolerable suffering results. High infantile mortality, the highest general death-rate, and one of the shortest average expectations of life in the world, are characteristics of the people of China. Many other diseases contribute to this, but public health experts have estimated that at least a quarter of all deaths in China are due to "fecal-borne diseases", i.e., diseases transmitted when night-soil is used as manure. These include cholera, typhoid, the dysenteries, summer diarrhoea, roundworm, hookworm, blood fluke, liver fluke, and others on a grim list. The deaths are only a part of the story;

for every person who dies, ten are made more or less seriously ill. The illnesses are often long, chronic, and debilitating and the cause of much human misery and distress.

Even in Japan, where every effort has been made to improve public health and hygiene, the death-rate still remains nearly twice that of some western countries. This is due in large part to fecal-borne infections, which cannot be overcome as long as the present manurial practices continue.

In fact, the natural organic manures used in Far Eastern agriculture kill several millions of people every year, and cause suffering to tens of millions. It seems a heavy price to pay, when alternative methods are available by which soils can be maintained at still higher levels of productivity. J. L. Buck, in *Land Utilization in China* remarks: "China can ill afford to use night-soil unless it can be made sanitary. From an economic viewpoint, it would probably be cheaper to throw away night-soil than to incur the losses concurrent with ill-health which result from its use." Thus from both the economic and the humanitarian viewpoints, the methods of maintaining "permanent agriculture" praised by King are to be condemned.

THE SADDLER: A VERSATILE RURAL CRAFTSMAN

JAMES WHITE

Rural Industries Bureau

ALL the world over, discerning horsemen speak with reverence of an "English" saddle. It implies the summit of craftsmanship in leather, the best that can be made. To the saddler himself the saddle is the pride of his craft, and from it he has taken his name in the same way as the wheelwright has called his craft after the highest achievement of his hands—the wheel. The saddler, however, is far from being a narrow specialist. He can turn his hand to most that is made of leather and much that is made from canvas; the catalogue of his products is legion.

The backbone of the craft is still saddle- and harness-making. It is certainly a shorter and more slender backbone than fifty years ago, when a man's station might be judged by his equipage; when a London household might boast a dozen high-stepping mares, and the meanest farm a pair of horses. Dashing down to Brighton in a phaeton can now only be regarded as an enterprising affectation, but today, perhaps more than ever, many ordinary young people spend their leisure hacking across our commons and along the chalk ridges of the downs. Horse-racing is still a flourishing industry and, of course, there is still hunting in our shires and point-to-points at Eastertide. In the towns there are still horse-drawn milk floats and drays; there are ponies in the mines and gay, prancing creatures in the circuses.

Despite the sad toll taken in the knackers' yard and the growing columns of tractors in the countryside, there are still horses on our English farms, both great and small. There is no end to the argument about the place of the horse on the farm: time and the young farmers of tomorrow, with their

eyes fixed firmly on the account books, will decide the issue. The danger is that they may not have the opportunity to judge the merits of the horse. There is a limit, too, to economic mechanization, and the horse often provides the fraction. Some small farmers cannot economically employ a tractor, and the horse remains. Of many small farmers in a district, perhaps one will buy a tractor and do contract work for the others, leaving them to do the routine cultivations by horse. On larger farms there may be too much work for one tractor, but not enough for two: here again the horse has its value.

Meanwhile, the fact remains that hacks and hunters, drays and pit ponies, farm horses and frivolous fillies in the ring, all need harness of one type or another. And they all look to the saddler to make and mend for them.

Sidelines But this is not the sum total of the saddler's work. For many years now he has had to resort to sidelines, and his shop illustrates his many interests. There are bridles with shining bits and kerb chains, soft travel bags and suitcases, halters, dog collars and leads, crops and lashes, and handbags of many styles to suit the promenade or the golf-course. But the obvious characteristic of each and every object is its good quality: good to look at, good to handle, good to smell.

Unless a village is in the middle of a hunting or racing district, there is unlikely to be sufficient work for a village saddler. Most of them have moved into the market towns, and the more ingenious and versatile have built up prosperous businesses, making, repairing, and sometimes retailing, travel goods and sportswear, repairing binder canvases, and so on, in addition to harness-making. Adaptability and versatility are most important qualities in the modern saddler, for sidelines can make all the difference.

In the bright days before the war, the gay trappings of the circus ring were made in Hamburg. Some circuses had their own saddlers, but, in the main, countries such as England, Sweden, and Belgium imported their circus harness from Germany. Needless to say, the circuses which regained their popularity after the war were hard put to find a substitute for the Hamburg saddlers, and, as has often been the case in the past few years, the English craftsman stepped into the breach.

There was an instance of a trainer with a team of circus ponies ready to be broken in who was bemoaning in a village inn the difficulty of getting show harness; someone mentioned a saddler in the Home Counties who might be able to help, and the trainer followed up the suggestion. The saddler had not previously made circus harness, but the idea appealed to him and he was anxious to try. With experienced hand and eye he measured up the ponies, carefully made a set in webbing, and fitted them. He listened closely to the trainer's needs and laboriously made all the necessary adjustments. Like a true craftsman he was not content merely to copy what had been made in Hamburg—great, heavy stuff which would have taken the strain of a team of Percherons. He sketched out something light and gay, more suited to the circus ring. His enthusiasm ensured him a free hand, and he set about making his first set of harness from lengths of leather gaily lacquered in blue, red, green, and white; the studs, buckles, and mountings for the plumes were made in shining white metal. The new work took endless patience and valuable time, but the saddler put all his skill and ingenuity into it. The cost of the set was more than he would risk charging a new customer, but he had the satisfaction of knowing that he had successfully made his first set of circus harness.

The ponies finished their training and went away to join a circus. The saddler bided his time. For a while it seemed as if his first set might be his last. Then came his first inquiry; he made some sketches for gay, light harness, took measurements, and was once again given a free hand to compose, from his brightly-lacquered leather, a set of harness which would dance beneath the bright lights of the circus ring.

Soon his reputation as a circus saddler grew. Orders came from the large English circuses, and then a commission from Sweden. So the saddler gladly stepped into the export market. He had to keep an open mind: circuses not only wanted harness for horses, they wanted bridles for elephants and muzzles for bears; there was even mention of giraffes. But the saddler found them all as amenable to the tape-measure as the horses.

Fortunately this saddler had a trainee from the Training Centre of the Rural Industries Bureau, and the trainee was able to carry on the routine harness-making and repairs while the master gave his mind to designing the new saddlery. As the circus work grew more hands were needed. Then the saddler had the idea that this colourful and delicate work for the circus might well be done by skilful girls. So he equipped an upstairs room as a second workshop with a long bench and the necessary tools, and installed three young "*saddlerines*," who soon learned the technique and took to the work.

Youth's Opportunity For many years now saddlers have had to look for sidelines, but the enterprising craftsman skilled with his knife and his needle can develop new and profitable work. Keen and versatile young men are still needed in the trade, and the Bureau is training a limited number at Wimbledon each year. For those who can develop their skill and their ingenuity with leather, there is a healthy career in a fine craft and prospect of taking over a business from an older man. Saddlery is a craft of many facets in which there is still a place for the rural craftsman.

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCTS INCLUDING GOVERNMENT GRANTS. (BASE 1927–29=100)

Month	Uncorrected for Seasonal Variation					*Corrected for Seasonal Variation*				
	1939	1946	1947	1948	1949	*1939*	*1946*	*1947*	*1948*	*1949*
January ..	96	199	217	242	245†	*89*	*179*	*193*	*215*	*218†*
February	94	201	211	240	243†	*88*	*182*	*190*	*217*	*219†*
March ..	90	192	201	232	237†	*91*	*183*	*191*	*220*	*225†*
April ..	90	176	186	214	227†	*95*	*182*	*192*	*222*	*237†*
May ..	82	162	171	198	208†	*91*	*181*	*192*	*223*	*235†*
June ..	80	161	170	198	207†	*89*	*181*	*193*	*225*	*236†*
July ..	85	168	181	199†	209†	*93*	*182*	*197*	*217†*	*232†*
August ..	87	176	192	211†	224†	*91*	*191*	*209*	*228†*	*244†*
September	93	177	206	210†	223†	*93*	*188*	*223*	*227†*	*242†*
October ..	97	192	222	225†	242†	*92*	*187*	*216*	*220†*	*234†*
November	107	209	235	239†	257†	*98*	*192*	*217*	*222†*	*236†*
December	114	214	241	245†	264†	*104*	*192*	*217*	*221†*	*235†*

† Provisional.

FARMING AFFAIRS

Plough for Plenty The Agricultural Expansion Programme, launched in the summer of 1947, set British agriculture a big task. It called for an increase in output, by 1952, of £100 millions, which amounted to a fifth more than in 1947 and roughly half as much again as the average output in the three years preceding the war.

So far as livestock and livestock products are concerned, our farmers have met the challenge splendidly. By Michaelmas, 1949, they had gone more than half way from the 1947 level. In the case of milk they have already reached the target set for 1952.

But the plain fact is that the same cannot be said of the crop targets. Between 1943 and 1949 the total area under crops in the United Kingdom fell from over 14½ million to 12⅔ million acres. Hence the point and urgency of the new " Plough for Plenty " campaign.

It is of vital importance that this trend should be reversed and that by 1952 the crop area should be raised to 14½ million acres. This is a task as great as any that has faced our farmers and their workers, but it is one that must be successfully accomplished.

Every farmer should ask himself whether his land is producing as much as it could, both of crops for direct human consumption and of feedingstuffs for his livestock. He should ask himself, also, whether he is diverting as much of his land as possible from grass to arable, and whether he is so improving his remaining pasture, both old and new, that there is no falling off in the supply of grass and grass products for his stock. Not all grassland is producing as much as it might. The use of the right mixtures when sowing new pastures, loosening established grass to let manures sink in, and, most important, using plenty of fertilizer—all these will help the farmer and, through him, the nation as a whole.

More and better crops, greater self-sufficiency by producing more food for man and beast—these are the urgent needs of our time and the objectives of the new " Plough for Plenty " campaign which aims at two million more acres by 1952.

Cereal Allowance for Whey-Fed Pigs Allowances of cereal feedingstuffs will again be available this year for feeding to pigs with surplus whey on the same conditions as last year. Where there are no arrangements for drying or condensing whey, it is important to use the surplus whey for pig-feeding if possible. This provides a supplement to normal rations and home-grown feedingstuffs ; but to meet cases where more meal is required to enable the whey to be consumed, County Agricultural Executive Committees are authorized to issue the following allowances of cereal feedingstuffs *as an alternative to the normal rations.*

March to June inclusive : 1 lb. for every 2 gallons of whey fed to pigs.
July to October inclusive : 1 lb. for every 1½ gallons of whey fed to pigs.

Farm cheese-makers and others applying to their County Agricultural Executive Committees for this alternative ration will need to provide evidence or estimates of the quantity of whey to be fed to pigs in specified months. Rations issued against estimates will be adjusted in later months when documentary evidence is available. The issue is not available to domestic pig-keepers or members of pig clubs.

This supplementary cereal allowance cannot be granted when whey ceases to be available. Pig feeders should, therefore, in their own interest adjust their operations before cheese-making stops so that their resources

will suffice to complete the fattening of the pigs or to allow of their sale to other fatteners.

Risk of Tuberculosis. The attention of stock-keepers is again drawn to the fact that whey may be responsible for tuberculosis among pigs. The incidence of tuberculosis in pigs fed on whey is high, and in such pigs the disease often assumes an acute form. Consequently, the carcasses of pigs fed on whey are more frequently condemned on account of tuberculosis infection than are the carcasses of other pigs. To guard against this danger *all whey should be boiled* before it is fed to pigs.

Agricultural Scholarships The Ministry of Agriculture and Fisheries invites applications for the undermentioned scholarships :

Ten Senior Scholarships, tenable at University Departments of Agriculture, or Agricultural Colleges, for degree or diploma courses in an agricultural subject ; or at Veterinary Colleges for courses in Veterinary Science ;

Six Extended Junior Scholarships (for those who have already held Junior awards), and

Sixty Junior Scholarships, tenable at Farm Institutes or similar institutions, for courses not exceeding one year, in agriculture, horticulture, dairying, or poultry husbandry.

The scholarships are open to the sons and daughters of agricultural workmen or of working bailiffs, smallholders and other rural workers whose means and method of livelihood are comparable with those of agricultural workmen, and to persons who are themselves *bona fide* workers in agriculture. The value of the awards is such that neither the recipients nor their parents are normally required to make any contribution towards the cost of the training provided. The usual method of selection is by interview, no written examination being held, but candidates must be able to satisfy the Selection Committee that they are in a position to derive educational benefit from the proposed course of instruction and that they intend to follow an agricultural pursuit on completion of their training. Candidates for Senior scholarships must have attained the age of 17 and for the Junior scholarships should in general be not less than 17 years of age on September 30, 1950.

Full information concerning the scheme and forms of application may be obtained from the Secretary (Room 314), 1 Cambridge Terrace, Regent's Park, London, N.W.1., or from the Education Offices of County Councils.

The latest date for submitting completed applications is April 30, 1950.

Post-Graduate Scholarships. The Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland propose to award, for the academic year beginning October 1, 1950, or earlier, a limited number of post-graduate scholarships in Agricultural Economics, Husbandry, Statistics, and Agricultural and Dairy Engineering. The closing date for applications is May 1, 1950.

Further particulars can be obtained from the Secretary, Ministry of Agriculture and Fisheries (Research Branch), 1-4 Cambridge Terrace, Regent's Park, London, N.W.1., or the Secretary, Department of Agriculture for Scotland, St. Andrews House, Edinburgh, 1.

Applicants resident in Northern Ireland should apply to the Ministry of Agriculture and Fisheries at the above address.

Romney Marsh: Report of the Agricultural Land Commission The Minister of Agriculture and Fisheries has now considered the report of the Agricultural Land Commission on the area of land in Romney Marsh referred to them for consideration under Section 84 of the Agriculture Act, 1947. The Minister

is in general agreement with the recommendations in the report, and in particular accepts the Commission's conclusion that all the recommendations for work to be carried out and fixed equipment to be provided for the full and efficient use of the land can reasonably be expected to be put into effect by the owners, lessees and occupiers in Romney Marsh, and therefore, it is unnecessary for the Government to exercise its powers of compulsory acquisition in this area. The Minister is proposing to ask the Kent and East Sussex Agricultural Executive Committees to make arrangements to implement those recommendations coming within their purview and to let him have periodical reports on progress, while the Ministry will follow up the other recommendations with the Authorities concerned.

The report itself is available from H.M. Stationery Office, or through any bookseller, price 2s. (2s. 2d. by post).

Grapes in Surrey Mr. Roy Hay, in a recent broadcast, referred to a movement which is on foot to grow grapes in the south of England. "Before the dissolution of the monasteries," he said, "there was a vineyard attached to practically every monastery and King James II had his own vineyard in the Thames Valley. Of course, we don't know what the wine was like, although some of the contemporary writings speak very well of it. We do know that the wine made from grapes grown only forty or fifty years ago in Glamorganshire always fetched a good price. But now there seems to be a possibility that the wine-making industry can be revived, and a valuable first step has been made on a south-sloping hillside at Oxted in Surrey, where Mr. Barrington-Brock has gathered together a large number of vines, many of them from the colder countries where grapes are grown, in an attempt to sort out those varieties which can be expected to crop heavily and reliably every year in these islands.

"Over fifty varieties of vines are being grown, and some remarkable facts have emerged from the experiments. For example, it has been found that Black Hamburg, always believed to be a good outdoor variety, is hardly worth growing compared with many other dessert varieties which have a much finer flavour. All the varieties commonly grown outdoors in Britain have now been discarded in favour of varieties brought from overseas, and it does seem remarkable that in all these years we should have been labouring under completely false ideas about the kinds of grapes which are suitable for outdoor cultivation here.

"The experimental plantings at Oxted contain both eating grapes and varieties for wine-making, and they are being grown both in the open and under glass cloches. There are varieties from Hungary, Canada, Switzerland, and many fine French varieties, including *Pinot Noir*, which is responsible for some of the finest wines in France. Attention is being given to special methods of pruning suitable for the climate in this country. It may be that we shall find varieties and methods of cultivation which will permit us to grow as good grapes in this country as in Northern Europe."

Extension of Calf-Vaccination Scheme Over one and a quarter million heifer calves and maiden heifers have been vaccinated against contagious abortion with S.19 vaccine under the Ministry of Agriculture's Calfhood Vaccination Scheme since it was introduced five years ago. There is evidence that the scheme is having a beneficial effect, and that vaccination is contributing to the increase in milk production and to improvement in fertility, more milk, and more calves.

Hitherto, the scheme has been restricted to herds which are subject to official testing or routine veterinary inspection, that is, to attested herds, T.T. herds and registered dairy herds. On April 1 next, however, the benefits of the scheme are to be extended to all other herds, including beef herds and rearing herds. Owners of these herds will then be able to have their heifer calves of four months old and upwards, and maiden heifers up to the time of first service, vaccinated at a low charge. A leaflet explaining the scheme will be available towards the end of the month from Divisional Veterinary Inspectors of the Ministry.

When the scheme was introduced the charge to the farmer (one shilling per calf) did not represent the full cost to the Ministry. Since then, costs have increased substantially. It is felt that farmers should now be asked to pay a larger contribution towards the cost of vaccination. Accordingly, it has been decided to increase the charge for vaccination under the scheme on and after April 1, 1950, to two shillings per calf.

Revolving Milking Platform Cows are to be milked by machines on an automatically revolving platform at the Camden Park Estate, New South Wales.

Work on the site of the plant has begun, but it will take 18 months to finish the scheme. The revolving platform, which will be partly manufactured in Australia, will accommodate 48 cows. It will complete a revolution in 12½ minutes, during which each cow will be washed, dried, and milked. After the cow has been milked, it will step off the platform and another will take its place.

The milk will be automatically weighed and carried through vacuum pipes to the milk bottling room. At no time will it be handled or exposed to infection. About 1,500 cows will pass through the revolving stalls daily.

Mr. E. Macarthur Onslow, manager of Camden Park Estate, which is part of the original 5,000-acre grant made in 1805 to his ancestor John Macarthur, pioneer of the Australian wool industry, hopes that the new milking system, which has been modelled on an American scheme, will reduce working hours and costs in the bulk milk industry.

Suffolk Village Our cover picture this month shows the magnificent green at Long Melford, Suffolk which, incidentally, is not far from Borley in Essex, whose rectory, until its recent destruction by fire, was notorious for its psychic phenomena. It is the largest village in the Sudbury and District Survey, noticed in the review of *A Full Life in the Country* on p. 599, and falls north and south of the Chad Brook on the main road from Sudbury to Bury St. Edmunds.

The village has a population of 2,521, and houses several rural craftsmen, including smiths, a saddler, and a wheelwright ; there are also small industries such as maltings, horsehair processing, and agricultural engineering.

In the valley there are tracts of alluvial and gravel soils, and much of the land is liable to flood. These areas are for the most part pasture. On the higher ground, in parts of Borley, the northern half of Long Melford and the greater part of Acton, the soil is developed from heavy boulder clay and arable cultivation predominates, although there are fairly large areas of woodland, heath, and parkland, the latter on the poorest soils. The well-knit farm units are from large to medium in size.

The report envisages a regrouping of Long Melford more compactly to the north, adjoining the green, and that the village should serve as a centre for the settlements at Liston, Borley and, to some extent, Acton.

A New Journal The first issue appeared recently of the Journal of the Science of Food and Agriculture. This new monthly publication of the Society of Chemical Industry aims at bringing together information on the practical application of chemistry to the growing and processing of food. It is hoped that each number will include a review of recent work in some branch of food and agriculture written by an authority in that particular field ; the review in the first issue is by Lord Bruce on the work of the Food and Agriculture Organization in relation to the world food situation. The annual subscription to the Journal is £1 10s., single copies 3s. Address : 56 Victoria Street, London, S.W.1.

THE MINISTRY'S PUBLICATIONS

Since the date of the list published in the December, 1949, *number of* AGRICULTURE (p. 442), *the undermentioned publications have been issued.*

Bulletins Copies are obtainable at the prices mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.

No. 81 Peas (*Revised*) 1s. 3d. (1s. 5d. by post).

No. 116 A Survey of the Soils and Fruit in the Vale of Evesham, 1926-1934 (*New*) 5s. (5s. 3d. by post).

No. 117 Diseases of Bulbs (*Reissued*) 5s. (5s. 3d. by post).

No. 142 Sugar Beet Diseases (*New*) 3s. (3s. 2d. by post).

Technical Bulletins

No. 2 Laboratory Methods for Work with Plant and Soil Nematodes (*New*) 9d. (11d. by post).

Leaflets Single copies of not more than 16 leaflets (four in any one group) may be obtained, free of charge, on application to the Ministry, 1-3 St. Andrew's Place, Regent's Park, London, N.W.1. Copies beyond this limit must be purchased from the Sales Offices of H.M. Stationery Office, net price 1d. each (2d. by post), or 9d. per doz. (11d. by post).

Advisory Leaflets

Group VI—Other Subjects

No. 188 Fold System of Poultry Keeping (*Revised*)

No. 338 Autosexing Poultry Breeds (*New*)

No. 354 Silage from Sugar Beet Tops (*New*)

No. 355 Acorns and Beech Mast as Feedingstuffs (*New*—superseding G.L. 39)

No. 356 Sugar Beet : Feeding Tops Green (*New*)

No. 357 Peas for Drying (*New*—superseding G.L. 59)

Animal Health Leaflets

No. 23 Tuberculosis of Cattle (*New*—superseding A.L. 223)

Other Publications

Allotments : Report of the Allotments Advisory Committee 6d. (7d. by post)

A.B.C. of Preserving (Superseding " Growmore " Bulletin No. 3) (Joint publication with Ministry of Food) 6d. (8d. by post)

Diseases of Animals Acts : Report of Proceedings under the Acts for the Years 1938-1947 2s. (2s. 2d. by post)

The Provision of Part-time Instruction by Local Education Authorities for Agriculturists, Horticulturists and Domestic Producers. Interim Report. (Joint publication with Ministry of Education) 1s. (1s. 2d. by post)

The Testing of Eggs for Quality (Joint publication with Ministry of Food) 1s. (1s. 2d. by post)

BOOK REVIEWS

Future Food and Agriculture Policy. JOHN D. BLACK and MAXINE E. KIEFER. McGraw Hill. 21s.

This book is a timely contribution to the cause of world food and agricultural planning. In it the authors have undertaken the gigantic task of analysing the world's food and agricultural problems, and they have suggested a programme of agricultural production and human nutrition which, with modifications for individual countries, they regard as suitable for world-wide adoption.

The book is divided into four parts. Part I outlines the position of world food and agriculture at present, while Part II analyses each of the main problems facing agriculturists and nutritionists, e.g. instability in agriculture, effects of population, changes on food requirements, conservation of agricultural resources, etc. In Part III existing food and agriculture programmes in operation in the U.S. and other countries are discussed, and finally the authors' idea of the perfect programme is outlined. Part IV discusses the roles of the different groups of the population in carrying out the authors' programme.

Throughout the book the two-fold objective of prosperous farming communities and well-fed populations is constantly kept in mind. Farm production policy is treated as being inseparable from nutrition policy. The authors take a realistic view of this, in that they make clear that if world-wide freedom from want is to be achieved there must be an adjustment of population to food-producing resources. They quote figures to show that at the present rate of population increase the resources of the world (including all untapped existing resources) would be insufficient to provide adequate diets by the end of this century.

Despite this realism, however, the reader may feel that the whole discussion, particularly when applied on a world-wide basis, is rather academic until a solution has been found for the problem of the world's dollar shortage—a problem which, for its solution, requires measures far beyond the fields of food and agriculture. Again, although the book is world-wide in its conception, the greater proportion of it is written in terms of conditions in the United States. Nevertheless, it is a book which can be recommended to all who are interested in world-wide food and agricultural planning. *J.A.Y.*

Farm Accounting and Management. FORD STURROCK. Pitman. 16s.

The avowed aim of the author to provide a useful book on farm book-keeping, accounting, and the maintenance of other records as an aid to farm management, is fully achieved. It can be recommended unreservedly to all farmers, farm students, farm colleges and institutes, as a most readable and useful exposition on an important subject. Not least of its merits, although written as a textbook it does not savour of the pedagogue.

The Cash Analysis system is rightly regarded as sufficient for the needs of the great majority of farmers, but the keeping of a Cash Analysis Account Book is not, however, enough in itself; supplementary records should be properly annotated. Very sensibly, the double entry system of book-keeping is not recommended for farmers, and only a small amount of space is devoted to explaining this system.

In Part II, Mr. Sturrock deals with Banking and Credit and that usually much neglected and untidy department, the farm office.

Part III goes further than most textbooks on farm book-keeping. The detailed analysis and examination of accounts enables the farmer to measure his farming efficiency, plan his future programmes, and detect weaknesses in organization. Many farmers fail to take their analysis of their farming transactions further than the annual Trading Account.

In Part IV Mr. Sturrock shows how the accounting principle should be applied to each separate farm enterprise. The overall picture shown by the Trading Account may mask profitable and unprofitable enterprises. The Enterprise Cost method quickly brings to light which are the profitable and which the unprofitable departments of the farm.

No book on farm accounts is complete without some reference to Income Tax, and Appendix I covers this subject as far as most farmers are likely to require.

R.H.

The Plant in Health and Disease. W. A. R. DILLON WESTON and R. E. TAYLOR. Crosby Lockwood. 21s.

The world shortage of food and the necessity for maximum production from farms in this country have focused attention on preventing loss from disease. The authors of this book, both of whom have had wide experience of plant diseases in the field, have outlined the general principles underlying the preventive and control measures aimed at reducing these losses to a minimum. As they so rightly point out, it is essential to start with a knowledge of the nutrients, soil conditions and other environmental factors necessary for growing healthy crops, and the principles on which good husbandry depends.

Too often it is not realized until too late that it is seldom possible to cure a plant once it has become infected. For this reason emphasis is laid on the importance of eliminating primary sources of infection. An up-to-date and comprehensive account of seed treatments—a subject in which the authors are particularly at home—shows how seed-borne fungi can be controlled. Examples of diseases caused by soil-borne fungi and those spread as wind-blown spores are used to illustrate the methods available for combating diseases originating from these sources.

In recent years the increased speed of transport and expansion of international trade has greatly increased the danger of introducing new diseases from abroad. It is therefore good to see, for once, a chapter devoted to legislation with an explanation of the powers that are taken to prevent the introduction of potentially dangerous "foreign" diseases and to limit the spread of native ones: the text of the Destructive Insects and Pests Act of 1927 is reproduced. An innovation is the inclusion in an appendix of a list of common diseases of our crops plants arranged alphabetically under the hosts.

The book is well illustrated with sixty plates comprising well over a hundred photographs of the parasitic fungi, the symptoms they produce on their hosts and the effect of a number of the diseases as seen in the field. It should prove of value and interest to the general reader.

F.J.M.

Fungi and Plant Disease. B. B. MUNDKUR. Macmillan. 16s.

Despite the progress made in agricultural education in India during the present century, few agricultural textbooks have been published in that country, and Indian students have had to rely very largely on books from Europe and America. Dr. B. B. Mundkur, of the Indian Agricultural Research Institute, New Delhi, has now met one need with an up to date student's textbook on mycology and Indian plant diseases.

Those who study any science, however, build upon the foundations laid by others—and so it is here. The author pays homage to one who blazed the trail. "Anyone," he says, "who undertakes to write a book on Indian plant diseases must be conscious of his indebtedness to Sir Edwin Butler, and a perusal of this book will show how much I owe to him and to his *Fungi and Diseases in Plants*".

Dr. Mundkur's book consists of twelve chapters. In the first four an account is given of the morphology and reproduction of fungi, their metabolic processes, the diseases that they cause and the methods of studying them. A short account then follows of the classification and naming of fungi. From here onwards the author treats the fungi systematically, and gives detailed descriptions of those which cause the important Indian plant diseases. The three concluding chapters deal with bacterial and virus diseases of plants and the general principles of plant disease control.

Fungi and Plant Disease is an authorative textbook that will not only be of great value to Indian students of mycology and plant pathology, but also of much interest to many in other countries, especially those who are engaged in post-graduate work and wish to widen their field of studies. It is clearly written, well illustrated and indexed, and at the end of each chapter there is a selected list of references. Further, bearing in mind that technical terms often present many initial difficulties to the student, the author has defined them wherever they occur in the text.

W.A.R.D.W.

Major Diseases and Competitors of the Cultivated White Mushroom. FRED C. ATKINS. Mushroom Growers' Association. 5s.

The need for a new edition of his booklet on mushroom diseases has enabled Mr. Atkins to add sections on the major competitors of the crop. Short, clear descriptions of characteristic sources of infection, prevention and control are supplemented by good photographs and diagrams and the booklet should, therefore, prove of real value to growers.

D.H.

Mushroom Research Station Report, 1946-48. Issued by the Mushroom Research Association Limited, Yaxley, Peterborough. 10s.

In early 1946 dwindling supplies of horse manure prompted a small group of mushroom growers to start an investigation on the problem of a synthetic compost. Thus began the Mushroom Research Association, which continued as a private institution until the end of 1948, when financial aid was given by the Ministry of Agriculture. The report deals with the results of the work done in the three years before this milestone was reached.

When account is taken of the variability and complexity of the media on which mushrooms are grown, it is not surprising that their culture is still more of an art than an exact science. Yet, as the report shows, the small team of workers at Yaxley has laid a foundation for the study of many basic problems. The results are given of preliminary experiments on important practical points such as depth of compost, rate of spawning, forms of nitrogen to use in synthetic composts, effects of growth substances, peak heat, time intervals between turning compost heaps, and the relation between number and size of mushrooms.

Side by side with these problems of culture, the Chemistry Department has carried out analyses of composts at various stages, and the report records changes which were found to occur in regard to *p*H, dry matter, moisture and nitrogen.

The Microbiology Department gives the results of a study of the microflora of mushroom-bed materials. Special attention is paid to those fungi which are pathogenic to the mushroom, as well as those which compete with it.

The report carries enough data to stimulate thought and discussion among those interested in mushroom growing for at least another three years.

H.H.G.

A Full Life in the Country. KEITH JEREMIAH. Batsford. 12s. 6d.

Here is a convincing case for local planning on what might be regarded as national lines. Mr. Jeremiah's book constitutes his report on a survey of the market town of Sudbury, Suffolk, and the surrounding villages. A particular feature of the enterprise is that it was sponsored by a local committee and paid for out of funds raised by public subscription. The general object was the planning of the kind of community that would both hold and attract a larger residential population, and at the same time preserve the beauty and character of the urban centre and environs. Present amenities are outlined and proposals made for future development of both the rural area and the suburban centre.

The author assumes the maintenance of a prosperous agriculture as a necessary background against which any planning should be carried out. The drift from country to town must be arrested. The countryman is now more alive to the amenities enjoyed by his town brethren, since modern communications, radio and cinema, have linked town and country more closely than ever before. The reader is taken step by step over the history of the area and the requirements to be satisfied. The pattern of the village cluster is described. The general plan might apply equally to other, similar areas.

This East Anglian farming area is typical of much of rural England which, on account of its geographical position, has escaped any large-scale commercialization. Mr. Jeremiah shows that the creation of the conditions necessary for the fuller life presents no insuperable difficulties. There is indeed something very vital and challenging about the whole enterprise.

The book is well illustrated and contains plans and diagrams necessary for a proper understanding of the proposals, especially for the stranger to the area.

Town and country planning is much in the public mind at the present time. This excellent analysis of a local problem and approach to a solution are commended to everyone interested in that kind of planning which will preserve all that is best in our English countryside; permitting development without denying the countryman the conditions necessary for the fuller life.

The illustration on the cover of this month's "Agriculture" is taken from this book and reproduced by kind permission of the publishers.

T.W.

Severn Stream. BRIAN WATERS. Dent. 15s.

There must be many who, like myself, found enjoyment in Robert Gibbings' *Coming Down the Wye*, and hoped that some day there would be a similar book about the Wye's sister river, the Severn.

That hope has been fulfilled in the present account of that lordly waterway of the Midlands; a river that never fails to stir our imagination as we think of it winding its way through the rich meadow land, past hop gardens and orchards, through the heart of England. Many of us know the Severn as well as we know the Thames. We have seen this river flowing across the Welsh border to where "the vanes of Shrewsbury gleam, islanded in Severn stream". And we follow it in our mind as it turns southwards on its long course to Tewkesbury where, within sight of Bredon Hill, it turns westwards towards Gloucester and the sea. It is a noble river and, like the Thames, never lacks enchantment at all seasons of the year.

Mr. Waters presents us with a somewhat impersonal account of his journey down the river from its source on lonely Plynlimon mountain, in Wales, to Tewkesbury. (It is on

Plynlimon, too, that the Wye has its source.) But he is a good reporter (in fact his book is very largely a piece of effective reportage), and he succeeds in making us see the river and feel its presence as we travel past those well-known cities and towns of the Midlands —Shrewsbury, Bridgnorth, Bewdley, Stourport, and Worcester—each making their contribution to the narrative. We meet many a local character, both Welsh and English, in the pages of this book, and there are pleasant passages about the fish, animal and bird life of the river.

Much painstaking work must necessarily go into the preparation of a book of this kind. It is a pity, therefore, that here and there the writing is of rather mediocre quality. A few of Mr. Water's metaphors, too, are somewhat startling, and occasionally imaginative rhetoric strikes an incongruous note.

On the whole, however, this book about the Severn makes smooth and informative reading until the last page where, in sight of that wonderful Norman tower of Tewkesbury's abbey church, Mr. Waters steps ashore from his river craft "on the soil of the town which from childhood to manhood was my home". It can be given a cordial welcome as a useful addition to our "river books". The 16 pages of photographic illustrations add to the reader's interest in the places and scenes described in the book.

A.H.H.

The Flower and the Wheel. ADRIAN BELL. The Bodley Head. 7s. 6d.

Since the publication of his first book, *Corduroy*, in which he described life as a farm pupil, Adrian Bell has written many books in a similar vein ; for he lost his heart to the peaceful countryside of Suffolk and became a farmer on his own account. Only a working farmer could have written with such insight, with such a sure touch and with such feeling. It is not surprising that his early triology—*Corduroy*, *Silver Ley* and *The Cherry Tree*—has, in the literary sense, lived and doubtless will go on living.

There is a marked maturity of thought and appreciation discernible in the author's latest book, *The Flower and the Wheel* ; the writing, too, is extremely good. Many will think, as I do, that it is the best book he has written so far. The book's theme is the harmony that can be found between the old and the new, between man and the machine. It is a relief to have a book that does not sentimentalize about "the good old days," that faces up to new ways of doing things and has little time for outdated customs. The only tradition of the land is that of the farming year : the ploughing, the sowing, the reaping and the thanksgiving.

The author has the intuitive faith that all good farmers have, faith in the land, in our country, and its people, and, above all, faith in the inner life of day-to-day existence. "There are many doors by which we enter life and there is one—apprehension of an inner life" he writes. He sees all machines not as abstract creations but, rightly, as patterns reflecting the human mind. Each machine is an idea, a piece of brain stuff "the flower of life lying within the law of the wheel". A valuable and timely piece of work, *The Flower and the Wheel* is a book to read again and again ; to keep handy for the quieter moments of life both in town and country.

A.H.H.

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Lessons from the Counties

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The Derbyshire farmer is presented with many grassland problems arising from variations in soil and altitude. His stock ranges from the hardy Gritstone sheep of the hills to the deep-milking cows maintained nearer industrial centres.

Yet his problems are basically the same everywhere — to grow the maximum of summer keep for his stock, while preserving —as hay, silage or dried grass — as much grass as possible for the winter.

Although much of the grass is on limestone, it is often short of lime. This deficiency is corrected by lime from the many quarries and kilns in the county.

In this high rainfall area, phosphates are rapidly locked up in the soil. Applications should, therefore, be little and often.

But the vital factor, here as everywhere, is nitrogen — fortunately in good supply. Nitrogen, coupled with wise and energetic management, will give ample grass for summer and winter use.

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